THE

ELECTRICAL REVIEW.

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"ELECTRICAL REVIEW."

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THE

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THE LONDON ELECTRIC TRAMWAYS.

TO-DAY the ceremonial opening of the *quondam* "experimental" conduit tramway between Westminster and Tooting will constitute the principal event in the eyes of Londoners. Thereafter the new tramway service will be at the disposal of the public, and we doubt not that the cars will be besieged by thousands anxious to celebrate the occasion in appropriate fashion. A full description of the newly completed section, and an outline of the works contemplated by the Council, will be found elsewhere in this issue.

By a curious chance, the controversy which has from time to time raged round the question whether the trolley or the plough should triumph, has been revived with renewed intensity by a report of the Highways Committee, which was laid before the Council on Tuesday last. The report covers the history of the matter from the beginning in 1900, when it was stated that the cost of reconstructing the whole system of 200 miles of track would probably amount to £3,000,000—at the rate of £15,000 per mile. This sum allowed for 2½ cars per mile, and was exclusive of car-sheds and workshops. Assuming an average speed of 8 miles per hour, the proportion of cars stated above would give a 3 minutes' headway. But when the estimates for the Tooting line were taken in hand, it was found that no fewer than 6·1 cars per mile were required, involving an increased expenditure for both rolling stock and power plant, at the rate of £3,880 per mile of track, per 2½ cars added per mile.

The tenders received for the reconstruction of the track on the Tooting section led to a revised estimate of £17,800 per mile for this work, including 2½ cars per mile, with power plant, but after deducting the amount received for "old rails, &c." To this must be added £5,587 per mile to allow for 6·1 cars per mile, with power plant, making a total of £23,387 per mile. The actual cost was £26,835 per mile, but from this must be deducted £2,075 per mile for car-sheds, and the sum received for "old rails, &c.," leaving an excess of "less than £1,000" over the estimates, which is ascribed to various causes. The report fails to mention the sum received for "old rails, &c.," hence the somewhat involved calculation given above.

The main fact is, however, that the actual cost of the Tooting section, *per se*, was £26,835 per mile, inclusive. This leads to the deduction that the cost of equipping the whole 200 miles of track which is taken as a basis of calculation may be, not £3,000,000, but more than £5,000,000—a remarkable difference indeed!

Taking the difference in cost of track construction between the trolley system and the underground conduit system to be £7,000 per mile, and assuming that all other factors are unchanged, the saving due to using the trolley system would be nearly 1½ millions sterling. Apart from this, the inconvenience caused to residents and occupiers

along the routes of the tramways would be enormously diminished, while so much of the existing road work could be utilised, and the time saved in the completion of the work would be so great, enabling the increased revenue from the converted tramways to be availed of much sooner, that the saving could safely be put at £2,000,000.

Perhaps the strongest arguments in favour of the trolley system are those set forth by the chief engineer and the tramways manager of the L.C.C. Tramways, in a joint report on the respective costs and relative merits of the overhead and underground systems. We need not recapitulate these arguments, as they are, for the most part, those with which our readers are well acquainted. We will content ourselves with expressing a pious hope that the Council will allow itself to be guided by facts, and will sternly put aside all such irrelevant considerations as the beauty (!) of the streets, the obstruction to fire escapes—of all contentions the most absurd—the renewal of the trolley wire, sparking at the wheels, &c., which have been put forward by Mr. J. A. Baker, chairman of the Committee, in defence of his pet scheme.

If the conduit must be used, let its use be confined to the most central parts of the town, and, in the name of commonsense, let the trolley system be adopted for all outlying lines. We make but one exception—the Observatory at Greenwich, which stands on a different footing from that at Kew, must be protected ; for this purpose the conduit is better than the double trolley.

Municipal Finance.

THE article on Municipal Trading, by a consulting engineer, which we publish in our other columns, presents an appalling picture for the ardent advocate of municipal "enterprise." It will be noticed that our contributor, in dealing with the question of depreciation, takes a standpoint with which we cannot agree, namely, he regards repayment of borrowed capital as depreciation of plant, although he refers to a business being self-supporting. But the striking point is this—even with this condition, he finds that all the municipal undertakings whose accounts he has examined were losing money during the year, some at a frightful rate. Where, we should like to know, would they be if a proper allowance had to be made, not only for repayment of loans, but also for the replacement of obsolete plant? This will be necessary, according to our contributor's figures, long before the debt is extinguished, and it will then be necessary to make heavy calls upon the rates. But it is precisely in order to avoid this, that we have consistently urged municipal authorities to lay aside a proper amount annually as a depreciation fund. The mischief of it is, that while these councillors make grants to the rates, and reap unmerited applause at the hands of the ratepayers, in many cases it will be upon others that the obloquy will fall. It is not for the councillors, however, that we are concerned, but for the unfortunate ratepayers, who cannot help themselves.

The Marconi See-Saw.

WE ventured to suggest in our recent commentary upon the Marconi Wireless Telegraph Co.'s report that the "payment of £16,443 by the Canadian Government can hardly be expected to be an annual event." Since we uttered that mild criticism, all sorts of things have happened in connection with Marconi telegraphy. It is perfectly true that the *Times*, with a great blast, introduced its service of trans-Atlantic Marconigrams; it is equally true that that service came to a sudden stoppage, and still awaits the renewal of some trivial mechanical detail of the apparatus ; it may also be true, as Earl Selborne said the other day, that wireless telegraphy utterly failed in connection with the Somaliland campaign. But, on the other hand, it is also a fact, that Marconi himself has been welcomed and applauded as a great hero by the Italian populace, and the great inventor's carriage drawn through the streets in regal style by an excitable mob; and, in response to public clamourings, he had to appear upon the hotel balcony, again and again to make graceful bows to his admirers. Here, indeed, we have a mixed reception ; the system criticised for its shortcomings, the inventor applauded for his great achievements. It is a strange and fickle world, and we have to take the sweet and the bitter together. But the unkindest cut of all comes from Canada, which has so fondly cherished Mr. Marconi and his system, and has so generously rendered financial aid. The news is this :—In the Canadian House of Commons, on May 8th, Mr. W. S. Fielding, the Dominion Minister of Finance, stated (we quote from the *Times* of May 11th) "that the Marconi wireless telegraphy system had not been the success hoped for, and the Government did not propose to make further contributions towards it." Then comes the same old story as was told of the *Times* Marconigrams, that there is only "a temporary breakdown of a mechanical nature." Well, all things considered, we do not think it necessary to alter our opinion "that the payment of £16,443 by the Canadian Government can hardly be expected to be an annual event." But, perhaps, the Canadian Government may be interested in cable shares? This has been said of some of us who dare to criticise.

The report from Rome that the results of certain recent experiments "*are regarded* as solving the problem of syntonisation," we accept with the utmost reserve, wondering *by whom* they are so regarded.

The Harmonising of Labour and Capital.

THE May issue of the *Engineering Magazine* contains a useful article from the pen of Mr. M. Cokely upon the above subject, in which the author lays down in simple language some of those fundamental truths which are often forgotten or misrepresented. He points out that although labour is undoubtedly entitled to a chance of earning a living, no one, not even the State, has a right to say to any employer that he must give that chance to any particular class of labour ; for it would be better that the employer should be taxed to support those who cannot get a chance to earn a living, if such there be, than that he should be interfered with in the management of his business. If all employers in the past had voluntarily conceded to their men all that they had a right to expect, without waiting for an organised demand or the expression of public opinion, less would be heard of the arbitrary demands of organised labour now. But since labour had the right to combine for support, unions must be recognised and accepted, and the proper course for employers to pursue is to combine among themselves. Union among employers is not only desirable for assistance and for resistance to the arrogant or unjust demands which any labour union may make, but it is also advantageous by teaching the employers the strength and responsibility of their position ; for upon them chiefly rests the commercial and industrial welfare of their country. The Employers' Federation was a strong tower during the engineering strike of '97. Organised labour is probably still ignorant of the irresistible power behind organised capital, and it is desirable that the men shall be taught this in time to avoid open conflict. Voluntary arbitration has proved useful, but it is only a temporary expedient ; and since arbitration practically means compromise, he whose demands are most frequent gains most. Moreover, arbitration means

a final settlement by the intervention of a third party, whose entry into the arena is not advantageous; and it is provocative of class distinction, by widening the breach between employer and employed, and by encouraging the latter to regard his union rather than his employer as his best friend—which helps to reduce the individual to a mere cypher. The better way of avoiding disputes is by mutual intercourse, discussion, and agreement; and by an improvement in the workman's position, allowing him to work shorter hours at higher speed, stimulating his ambition, rewarding him and protecting him, giving him a pecuniary interest in his business, and inaugurating a "committee for the encouragement of the willing worker."

Leakage from Gas Mains.

THERE are few more prolific sources of accident than those from leakages of gas mains, whether from the constant habit of people to seek for them with a naked light, or in the explosion of the accumulated gas by its coming into contact with fire—the introduction of a lighted candle or an electric spark. The condition of the gas mains all over the country, and especially in towns where they have been underground for long periods, is very bad—as anyone can judge who approaches an opening in the streets where the earth is being disturbed in their vicinity, but it is of especial importance to the engineers and managers of electric works, whose trenches, manholes, inspection boxes and chambers are liable to be invaded by the noxious and dangerous vapour. In their interest especially, we direct attention to the protective clauses in the Acts of Parliament, under which the gas companies are liable to heavy penalties if they permit escapes of gas after due notice has been given to them.

Clause 24 of the Gasworks Clauses Act, 1847, provides that whenever any gas shall escape from any pipe laid down or set up by or belonging to the undertakers, they shall immediately after receiving notices thereof in writing, prevent such gas from escaping, and in case the undertakers shall not within 24 hours next after service of such notice effectually prevent the gas from escaping, and wholly remove the cause of complaint, they shall, for every such offence, forfeit the sum of £5 for each day during which the gas shall be suffered to escape after the expiration of 24 hours from the service of such notice. This being the law of the matter, engineers and managers should immediately give formal written notice to the gas authority upon detecting an escape and see that it is at once remedied.

The Electric Lighting Acts are based upon those which were previously enacted to govern the supply of gas, so that the regulations in the interest of public safety and convenience with respect to electric supply are similar to those in the Gas Acts. If a gas company or local authority require to carry out works in connection with their undertakings, which are likely to endanger or inconvenience in any way the electric lighting or tramway works of a company, notices should be at once issued requiring proper arrangements to be made before commencing such works, so that the interests of the company may be protected and compensation obtained in case of loss or damage being sustained.

Every one having statutory powers which enable them to interfere with the public highways—be they Local Authorities, the Post Office, Gas, Water, Telephone, or Electric Light Companies—are under legal obligations to carry out their undertakings in a way that will not injure one another, thus under Sec. 15 of the Electric Lighting Act, 1882, it is provided that no interference with pipes or wires is allowable without "previously making or securing such compensation to the owners of such pipes or wires, and on complying with such conditions as to the mode of making such alterations as may before the commencement of such alterations be agreed upon between the undertakers and owners."

Cases have arisen where serious injury has been done in consequence of proper precautions not having been taken, and in the case of explosions of gas, they might probably have been prevented if notice had been given to the gas authority immediately an escape was detected.

In the official accounts of electricity supply undertakings, the difference between the current generated and that accounted for, is rightly considered of some importance, and it is of equal interest to study the returns from all the gas undertakings giving similar information as to the quantity made and sold. If these records of the escape of a dangerous explosive were published, it might prompt an examination by a Government Inspector into the condition of gas mains, which would be very instructive.

The Acts of Parliament, Provisional Orders, Bye-laws, and regulations which control the works in question are a formidable study, but the engineer-managers of electric supply works and tramways, are bound to become as familiar with them as with the technical duties entrusted to them when they combine in themselves both the engineering and commercial management of the undertakings.

Labour Legislation.

ALTHOUGH the supporters of the Trades Disputes Bill have failed to make out a case for the modification of existing law relating to picketing and conspiracy, they have succeeded in securing the appointment of a Commission to inquire into the law relating to trades unions and kindred matters affecting master and servant. For our part, we are not surprised that this result should have been brought about by a narrow majority. It is true that recent decisions in the Courts have seriously crippled the powers of the unions, and have shown that for nearly 30 years these organisations have been allowed to exercise powers which, according to the true construction of the Trade Union Acts, were never conferred upon them; but we have yet to learn that the great principles of justice which underlay these decisions are condemned by the voice of public opinion. Moreover, a close inspection of the facts of the Taff Vale Railway Co. *v.* The Amalgamated Society of Engineers, and the numerous other cases which have recently been heard, afford a clear indication that however much the officials of the unions may desire to observe the law, the members too often take the bit between their teeth. It is to be presumed that those who desire the appointment of a Commission also demand a change in the law. Those of the Labour Party who supported the motion for the appointment of the Committee are naturally desirous of whittling away by direct legislation the effect of cases which have declared certain acts done in pursuance of a strike to be illegal. This object was to be attained by an Act which declared that picketing for the purpose of peaceful persuasion should be legal, and that the law of conspiracy should (in effect) be suspended for the purposes of trade disputes. It is not to be wondered at that Parliament has refused to countenance any such measure. We have, however, already expressed the view that there is urgent need for a more lucid statement of the law than that which is to be gathered from the Statute Book and the law reports (see ELECTRICAL REVIEW, March 20th, 1903, p. 474). The necessary preliminary to a new Act is an inquiry by a Royal Commission. The scope and objects of such a Commission were well defined by Mr. Haldane when he said:—"What I should like to see would be the appointment of a Royal Commission. It should consist of three experts, say, two of the most eminent judges in the land, and some layman who has a wide experience of trades unions, and who takes a fair view of them. This Commission should be asked to decide whether the present decisions can stand together, and if they cannot stand together, I should like the Commission to say what the principles of law really are. The Commissioners might also deal with the question of picketing, providing always in any suggestion made by them that the liberty of the subject should never be interfered with by the legislation of a nuisance."

ELECTRIC DRIVING IN MACHINE SHOPS, ENGINEERING AND SHIPBUILDING WORKS.

THE above subject was dealt with in two papers read before the Inst.E.E. on 7th inst.

One, by Mr. A. B. Chatwood, deals with three examples of electrical driving in small machine shops, the powers being from 20 to 40 H.P. The other, by Mr. A. D. Williamson, is a detailed description of the driving arrangements at the works of Messrs. Vickers, Sons & Maxim.

The author of the first-named paper will scarcely claim that his contribution adds much to the sum total of knowledge previously existing on the subject. The impression

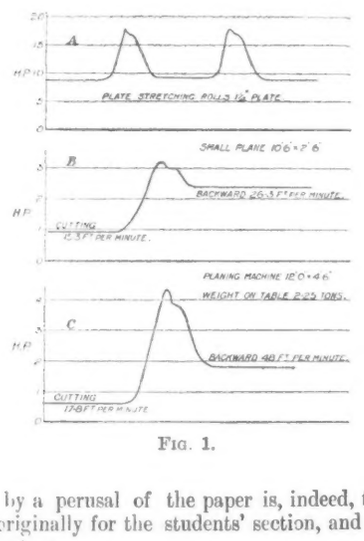


FIG. 1.

conveyed by a perusal of the paper is, indeed, that it was intended originally for the students' section, and has somehow gone astray.

For it is surely not necessary in these days—at any rate it ought not to be—to tell any electrical engineer who has got beyond the student stage that it might be advantageous to replace by an electric motor "a Robey portable made at a very early date, and a small single-cylinder horizontal with vertical boiler placed in the smithy," both engines being "entirely worn out." It would seem perfectly obvious that to replace such decrepit and obsolete engines by anything at all would be an advantage from any point of view. The annual cost of running these engines was £378 exclusive of interest and depreciation. Of this sum, coal, water, oil, and wages account for £311, and repairs, £61.

The cost of driving by a single 20-H.P. motor was, for the same period, £186, of which the cost of current accounted for £164, and interest and depreciation at 10 per cent., £18. The annual consumption is 36,804 units, so the costs work out at about 1·07d. per unit. The works

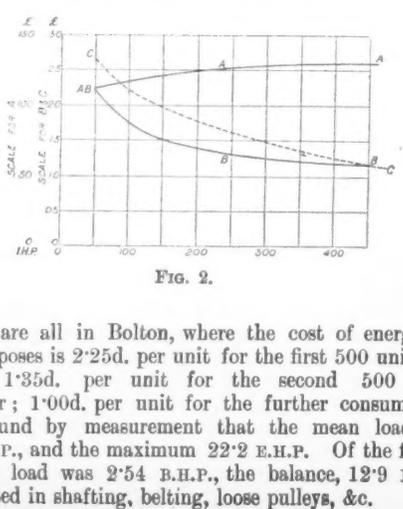


FIG. 2.

described are all in Bolton, where the cost of energy for power purposes is 2·25d. per unit for the first 500 units per quarter; 1·35d. per unit for the second 500 units per quarter; 1·00d. per unit for the further consumption. It was found by measurement that the mean load was 15·44 E.H.P., and the maximum 22·2 E.H.P. Of the former the useful load was 2·54 B.H.P., the balance, 12·9 E.H.P., being wasted in shafting, belting, loose pulleys, &c.

A sketch plan of the driving arrangements is given, which shows that the power is transmitted from the motor to the tools through a main-shaft, bevel gear, and two or three intermediate shafts, as is not uncommon in old shops.

The author then estimates the economy that might be secured by sub-dividing the power into 14 motors ranging in size from 1½ H.P. to 7½ H.P., averaging 2·8 H.P.

The cost of current would be reduced from £164 to £44, the total cost, including 10 per cent. on the installation, being but £91 10s., as against £186 for the single-motor arrangement.

The second case instanced is a shop originally driven by a single-cylinder condensing beam engine having a cylinder diameter of 25 in. and a 6-ft. stroke.

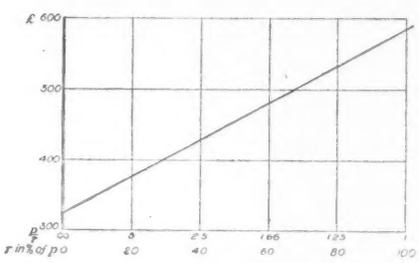


FIG. 3.

The mean load was 26·6 I.H.P., and the maximum load 34—40 I.H.P. The mean useful load was 4·6, and the power wasted in engine, shafting, &c., 22 I.H.P. The total costs are not given, but the annual coal bill was £430, which works out to nearly 1·3d. per I.H.P.-hour.

Assuming 21 B H.P. to be the mean load on the shafting, the author estimates the cost of energy, if the engine were replaced by a single 40-H.P. motor, at £231 for a year of 3,000 hours, which, with 10 per cent. on the cost of the installation, and a small charge for brushes and cleaning, brings the total annual cost to £264, against about £600 for the engine costs.

Apparently the author's advice was not adopted in this case, as he says, "As a matter of fact, the drive is being divided over four motors—with what object the author fails to understand, since the whole of the shafting is to be driven and no one of the advantages of electric driving is to be secured."

But what are the advantages of electric driving? Among the nine possible advantages enumerated by the author are: "Convenience on occasional overtime; the very partial nature of a breakdown, and rapidity of repair; facility with which power measurements may be made." These three advantages are, to some extent, secured by the partial subdivision of the power. Again, each shaft driven separately

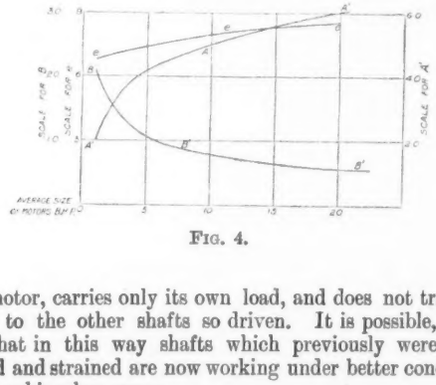


FIG. 4.

by a motor, carries only its own load, and does not transmit power to the other shafts so driven. It is possible, therefore, that in this way shafts which previously were overworked and strained are now working under better conditions and absorbing less power.

It is not at all certain, therefore, that the four motors would, as the author estimates, consume more energy than one larger motor.

By sub-dividing the power over 18 motors ranging from 1½ to 6 H.P., giving the advantages of speed control, it is estimated that the annual cost for energy would be only about £95, as against £231 with the single-motor arrangement, and the total costs £191 instead of £264.

The third example given relates to a new works which it

is proposed to drive electrically, but only in a half-hearted sort of way.

The work carried on is brass-finishing, and the tools are used very intermittently, so that the useful energy forms only a small portion of the total amount metered. From observations made, it was estimated that out of 174 units consumed, only 14 were actually used on the tools.

By further sub-dividing the power, applying separate motors to the planing machines and lathes, and cutting some of the shafts, the dead load could be reduced to 1·86 H.P., and the annual cost for energy reduced from £56 to £29, the total costs being reduced from £68 to £48.

One interesting point in connection with this installation is that it was found on testing a 5-H.P. motor, by a well-known maker, that it absorbed 2·65 E.H.P. when running light; this was reduced to 2·47 E.H.P. by a re-adjustment of the brushes; but there is room for very considerable improvement upon this figure.

Generally speaking, the author is of opinion that to drive line shafts by separate motors, or to drive a works by one motor, is foolish and uneconomical, as gas or oil engines would be cheaper and quite as satisfactory, an opinion that will not be accepted generally. On a steady load a gas or oil engine might prove more economical than a motor, but on a variable load a motor will in a large percentage of cases have the advantage, besides occupying less space and requiring less attention.

The author gives some horse-power diagrams, which we reproduce in fig. 1. From these it will be seen that in a 12 ft. × 4 ft. 6 in. planing machine the power taken when cutting at the rate of approximately 18 ft. per minute is slightly over ½ H.P.; at reversal it is over 4 H.P.; and when running backward at 48 ft. per minute the power is nearly 2 H.P. The weight on the table was 2·25 tons. The actual mass moved, including the table, is not given, and in any case the diagrams do not help us very much, as it will be seen that a planer half the size, viz., a 10 ft. 6 in. × 2 ft. 6 in. cutting and travelling backwards at considerably slower speeds than those given for the larger machine, takes a much greater power. The nature of the cut, and the weight on the table will affect the power, whilst the speed at which the mass is started from rest and accelerated has a marked effect on the shape of the peak at reversal. We are not told how the diagrams were taken, whether by means of a recording ammeter, or constructed partly from imagination, based on the swing of an ammeter needle. Curves or diagrams constructed on this method are generally very different from what would be obtained from a recording ammeter, with a quick paper speed. Neither is the time in seconds marked, and it should be borne in mind that the shape of the curve is affected very considerably by the length of record per second.

Reference is made to the starting of machines with large inertia, such as grind-stones. A stone 7 ft. in diameter, we are told, absorbs from 2½ to 5 H P. So that a 4-H P. motor is large enough to drive it, but the inertia is such that it takes a 15-H.P. motor to start it. Probably the author means that it takes about three or four times the full load torque to start the stone, which is not quite the same thing. A controlled magnetic clutch device is described, operated through the starter. The motor is first run up to speed, after which any further movement of the starter cuts resistance out of the clutch circuit, which thus gradually takes up the load. It would appear from the description that the speed of the stone can be controlled and varied by this means. If so, the problem of a mechanical variable speed-gear is solved. Perhaps we misunderstand the sentence "There is, of course, the advantage also that the stone can be driven at the best peripheral speed irrespective of its diameter"; but as this advantage is claimed for the clutch, it can only mean that it is intended to use it for speed control.

The author finally evolves curves and formulæ by means of which it is suggested that comparisons may be instituted between the costs of steam and electrical driving.

The cost of steam driving is expressed by the formula $A + Bp + Cr$,

Whilst for electric driving the cost is found from $A'n + B'p' + C'r'$, where

A, B, C are constants expressed in £ per annum.

p is the maximum I.H.P. in the engines.

p' is the maximum B.H.P. in the motors.

r is the mean I.H.P. taken over the year.

r' „ B.H.P. „ „

n is the number of motors.

A is wages in looking after boilers, engines, shafting and belts.

A′ is wages per motor, looking after motors, shafting and belts.

B is interest, depreciation, repairs, rent.

B′ „ „ „

C is coal, oil and stores.

C′ is annual cost of one B.H.P. in £.

C′ is given by

$$\frac{1}{e} \times \frac{746}{1{,}000} \times \frac{x}{240} \times \text{hours of running} \times r' \text{ where } e$$

represents the efficiency of the cables and motors as a fraction of unity.

x the cost of energy in pence per unit.

The values of the constants are given for a few cases in the curves in figs. 2, 3 and 4.

In some cases such formulæ may be of assistance, but we live in a very practical age, and a works owner would be very sceptical about any savings estimated on these lines.

In most cases the engineer who is constantly engaged in transforming works from steam to electrical driving knows intuitively by inspecting the works whether or not a saving can be effected, and is able to show by simple arithmetic what-the probable saving will be.

(To be continued.)

PARLIAMENTARY.

South Lancashire Tramways Bill.

On Wednesday, May 6th, a Select Committee of the House of Lords, presided over by the Earl of Lauderdale, considered the Bill of the South Lancashire Tramways Co. The Hon. J. D. Fitzgerald, K.C., and Mr. L. Mackassey appeared for the company. The Bill was opposed by the Lancashire County Council and the St. Helens Corporation.

Mr. Fitzgerald, in opening the case for the petitioners, said that the object of the Bill was to authorise the South Lancashire Tramway Co. to construct tramways and for other purposes. The company was authorised in 1900 to construct an extensive system of tramways, which, when connected up with the existing tramways, would extend from Liverpool to Bolton, Wigan, Swinton and the South Lancashire towns, making a connection with Manchester and Salford. The total mileage sanctioned was 100, and 30 miles were already being worked, for which purpose the company had constructed a very large electrical generating station. The lines actually working commenced at Haydock, and passed north in the direction of Wigan, and *vid* Atherton to Bolton. By the Bill now before their Lordships, the company sought power to construct a few small additional tramways to give additional convenience in working the lines already authorised. Four years was the period originally fixed for the construction of the tramways, but it was obvious that such an extensive system could only be proceeded with gradually. The company was most anxious, as were the local authorities, that the lines should be constructed as soon as possible, but the company needed an extension of two years for the construction of the tramways and the acquisition of the land. The only objection by the local authorities was that they did not wish the construction of the tramways deferred, but it would be very difficult, if not impossible, for the company to carry them out within the original time. Another proposal in the Bill was with regard to St. Helens. There the tramways were leased by the Corporation to a company, and they intervened between the lines of the South Lancashire Co. and the Preston and Liverpool Light Railway. One of the objects of the South Lancashire Tramways Co. was to have direct communication between the docks at Liverpool and the towns of South Lancashire, over the Liverpool Corporation tramways, the Prescot and Liverpool line, the St. Helens tramways and the South Lancashire tramways. In the Act of 1900 authorising the tramways, there was a clause to the effect that no running powers were to be taken over the lines in St. Helens without the consent of the Corporation. That might be very well when the Corporation were running the tramways themselves, but they had leased them, and there was 18 years of the lease still to run. The St. Helens Corporation had refused to allow the lessors to enter into any arrangements with the company without their consent.

Mr. Ram, who appeared for the St. Helens Corporation, said the Committee ought to be told that the lease had been granted to the company before 1900, and the clause in question was put in as an agreed clause.

Mr. Fitzgerald said that was so, but the difficulty of working was not then foreseen. They never anticipated that the St. Helens Corporation would object to their taking their cars through their town. It was in the interests of the travelling public that there should be through running, as an exchange of cars at different

points meant inconvenience and delay. He asked the Committee to have regard to public interest in that matter by repealing the section and not allow the St. Helens Corporation to continue its unreasonable and obstructive attitude. All they asked for was mutual running powers on such terms as the Board of Trade would settle. Another object of the Bill was to obtain power to divide the system into stages and charge a 1d. for certain stages, instead of making a maximum charge of 1d. a mile. Other provisions of the Bill were as to waiting-room accommodation, power to supply electricity to authorities under certain circumstances, and the repeal of the clause in the Act of 1900, which compelled the company to carry bicycles and perambulators. The latter could only be carried in trailer cars to which the Board of Trade objected.

Mr. J. R. Salter, the engineer-in-chief to the promoting company, gave evidence bearing out counsel's opening. He said that the South Lancashire system was probably the biggest tramway system ever authorised by a single Act. The progress made by the company in the short time since they obtained the Act was, he considered, phenomenal. He did not know of any local authority that had constructed so many miles of line and opened them to public traffic in so short a time as had his company. They were very anxious to push on with the construction of the complete scheme, but in view of its length it was impossible to have it completed within the original time limit.

Mr. Waller, C.E., also gave evidence in support of the Bill, and said that unless they could get running powers through St. Helens it would be impossible to have a through service of tramways between Liverpool and South Lancashire towns, as was the object of the promoters. The company who worked the tramways in St. Helens did not object to their having running powers, it was the Corporation who were the objectors. It was all a question of reasonable interchange of traffic, and the South Lancashire Tramways Co. wanted it settled by the Board of Trade. They regarded the St. Helens Corporation as using their strong position by trying to impose most absurd terms upon the company.

Mr. Lankester, on behalf of the Lancashire County Council, contended that they had a right to ask the Committee not to alter any of the clauses in the Bill of 1900, unless the County Council was agreeable.

Mr. Shaw, on behalf of the Mining Association, asked that the 12th Section of the Light Railways Act should be applied to the present Bill, and that instead of it being optional for the company to carry goods and minerals, they should be compelled to do so.

The Chairman intimated that the Mining Association had better not press that point.

Mr. Ram then addressed the Committee on behalf of the St. Helens Corporation, and said it was necessary that a borough should be master in its own district. The Corporation had not refused to meet the company, nor had they asked anything that was unreasonable or impracticable.

The Chairman said the Committee were agreed that the company should be given the extension of time asked for in the Bill. They also granted the power to fix stages and charge 1d. fares as sought. Houghton was to remain as it stood under the Bill of 1900. Regarding Wigan's running powers, the Committee could only bind the company's action, and could not control Hindley. With regard to St. Helens, they had decided that running powers should be given for the period of the lease, restricted to passenger service only, on arbitration terms. It was to be understood that passengers' luggage would go as part of the passenger system.

On the consideration of clauses, Mr. Balfour Browne submitted a clause to carry out the decision of the Committee that the promoters' compulsory running for the St. Helens tramways should be confined to passenger traffic.

Mr. Ram hardly thought the clause specific enough.

The Chairman allowed the clause, and said that what was in the minds of the Committee was that while goods should not be carried, passengers' luggage to the extent of 28 lbs. should be allowed.

The clause relating to the fixing of fares was agreed to as follows, after prolonged discussion:—"That the company must, with the agreement of the County Council, fix stages for the regulation of fares on the general principle of 1d. a mile." A proviso was added to the effect that "nothing in the clause should prejudice the right of the Corporation of Leigh as reserved to them by the Act of 1900."

Somerset and District Electric Power Bill.

On May 5th and 6th the Select Committee of the House of Lords, presided over by Lord Glenesk, considered the above Bill. Mr. Shiress Will, K.C., Mr. Acworth, and Mr. Macassey appeared for the promoters. The Bristol Corporation, represented by Mr. Balfour Browne, K.C., Mr. Freeman, K.C., and Mr. H. Gregory, and the Bath Corporation represented by Mr. L. Coward, K.C., and Mr. Mr. J. A. Sinier were the principal opponents. Mr. Ram, K.C., represented the West Gloucestershire Water Co., and Mr. Balfour Browne, K.C., Mr. Ram, K.C., and Mr. Gregory the Bristol Water Co.

Mr. Shiress Will, K.C., in opening the case for the promoters, said it was proposed by the Bill to generate electricity for power purposes throughout the whole of the county of Somerset, a portion of the county of Wilts, and a small portion of Gloucestershire. It was promoted mainly by local people. Amongst them was Mr. P. W. Miles, who owned an estate of 3,000 acres of building land near Avonmouth Docks; Mr. Manger, of Bath, and Mr. Armstrong, a partner in a firm of mechanical engineers at Bristol. Mr. Mason, who was connected with the Yorkshire Power Co., and was well acquainted with such schemes, was also connected with it, and he thought that evidence would show that if sanctioned there would be an abundant demand for electric power to satisfy the claims of the capital which would be expended. The area of supply included Bristol, Bath, Wells, Glastonbury, Radstock, Frome, Shepton Mallet, Street, Trowbridge, and other places where there were many industries carried on. It was proposed to put down two generating stations—one at Radstock, and the other at Henham, which was just outside Bristol, and the intention was to erect the Henham station first. The opposition to the Bill came mainly from the Corporations of Bristol and Bath. The electric lighting was in the hands of the Corporation of Bristol, and they also supplied electricity for power purposes to a certain extent, but the outlying suburbs remained unsupplied. There was one important factor in the case. The Avonmouth Docks were being extended at a cost of £2,000 000, and at present the only electric power there was supplied by gas engine-driven generators. There was, however, no electric main carrying a supply down to the docks. He would point out that there was a clause in the Bill which stated that the company could not supply in the district of any authorised undertakers without the consent of such undertakers, and, therefore, if the Bristol Corporation were supplying, they could refuse to allow the company to come in. If, however, such consent was unreasonably withheld, it was competent for the Board of Trade to dispense with the veto. The capital proposed was £750,000, with the usual borrowing powers, and the promoters had every confidence in the undertaking being a commercial success. In Bath the Corporation supplied electricity at a loss, and the rates had to be resorted to, and further expenditure would be necessary if any good was to be done. Bath, of course, was protected by the same clause as Bristol; and if the Corporation gave a supply for power purposes within a reasonable time and at a reasonable price, the company could not get in. The Bath Corporation also objected to the company laying mains by reason of the fact that the cellars of the houses ran a great way under the streets. In that connection there had been no difficulty in dealing with a similar state of things in the City of London, and the company offered a clause making the Board of Trade arbitrators as to the route to be traversed. The opposition of the water companies came from the fear of electrolysis, but that was a matter which had been fully considered by Parliament, and the Board of Trade had declined to insert any special protective clauses.

Mr. David Capper, the engineer to the scheme, said he had had considerable experience in electrical engineering and in the designing and construction of electrical plant. He proceeded to give the populations of the chief towns included in the area, and described the various industries carried on in them. In connection with the extension of the Avonmouth Docks, the scheme would be particularly of great use. Altogether, the district was eminently suitable for a power scheme, and at present there was no adequate supply for power purposes. With the exception of Bristol, Frome, Bath, and Trowbridge, no towns in the district had provisional orders for lighting. Wells did have a provisional order for some years, but it was revoked by the Board of Trade, as it was not put into operation. In Bristol they had two entirely different plants for lighting and power. They had the alternating and continuous systems; and it was quite incorrect for the Corporation to say that, if the company came in, they would be deprived of the advantage of using the day load, because, instead of using the day load of their lighting plant for power purposes, they had an entirely different plant. The electric lighting undertaking was nearly idle during the day, whereas the power undertaking was standing on its own basis, and therefore the introduction of power by the company would not directly affect the lighting undertaking of the Corporation. In Bristol the cost of generating electricity worked out at 2·3d. per unit, and the Corporation charged 1½d. per unit for power, and made up the deficit from the lighting undertaking. The proposed generating station at Hanham was at the pit's mouth, so that the coal would be as cheap as it was possible to get it. At Radstock they had the River Somer, and also abundant railway facilities, and if the Bill were passed there was no doubt that they would be able to supply Bristol much cheaper than the Corporation. Their buildings would not be put up in that extravagant way which was deemed necessary by municipalities, their site would be cheaper and their facilities better. They intended to equip the station with a capacity of 20,000 kw., which they considered suitable for the requirements of the district for many years. If they got a load factor of 25, the cost of generating would not exceed ¾d., and if this expectation were realised there would be a revenue ample to pay 8 or 9 per cent. on the whole capital. In the case of Bath, at present there was no power station in operation, although a continuous current plant was being proposed for the central part of the town. For the supply of light the current was alternating.

In cross-examination by Mr. Freeman, Witness said he had not been connected with a power scheme as engineer before. He did not take it that it was the universal rule of Parliament to exclude towns of the importance of Bristol when they objected to such schemes. He was aware that some large firms in Bristol were being supplied with power to some extent by the Corporation because they could not get better. His experience was that companies could supply cheaper than corporations, and of course they would not think of going before the Board of Trade unless they could.

Mr. James Swinburne was also called, and stated that the area scheduled for supply was about 600 square miles. There were 43 local authorities, and he submitted that the scheme would be a benefit to them, inasmuch as they would be able to buy of the company cheaper than they could themselves make electricity.

Evidence of a similar kind was given by Mr. A. Campbell Swinton, and a number of local witnesses were called to prove the need for a supply of electrical energy for power purposes.

Mr. Freeman, K.C., addressed the Committee on behalf of the

Bristol Corporation, and submitted that Parliament had always excluded large towns from the areas of supply of power companies. He asked the Committee to do the same with regard to Bristol, and to make the exclusion extend to any new boundaries which might be granted to Bristol during the next two years.

Mr. Alderman PEARSON, chairman of the Bristol Electric Lighting Committee, said the Corporation had never refused a power supply to any person where there was any little margin of profit. Their charges compared favourably with other large municipalities, and were cheaper than most of them. The Corporation had expended over half a million of money in the undertaking, and if the demand increased in the future they would be able to reduce their prices again. It was not true that they supplied at a loss, for they had two prices which must be averaged. While he was not afraid of the company doing them any harm, still they did not want to be brought before the Board of Trade as they might be if the Bill were allowed.

Mr. LEWIS COWARD, in addressing the Committee on behalf of the Bath Corporation, contended that the promoters had entirely failed to give sufficient reasons why Bath should be included in the scheme. They had not given evidence to prove that the enterprise and works of the Corporation were in an unsatisfactory condition, or that the rates had to be charged to make up the deficit in trading, and that further expenditure would be necessary if the Corporation were to do good business. As a matter of fact, despite early vicissitudes, the Corporation undertaking seemed now to be entering upon an era of prosperity. The Corporation were not unmindful of their obligations in the matter, seeing that they were committed to an expenditure equal to one-half of their rateable value. He put it to the Committee that the promoters had entirely failed to establish their case.

Mr. SHIRESS WILL, K.C., in replying for the promoters, said that the issue, as far as Bath was concerned, was whether, in case of any deficiency in supply, somebody should not be at hand to step in with the authority of the Board of Trade and make good the default. There was certainly a very large scope for the use of electrical power in Bristol. It was not correct to say that Parliament had always excluded the large towns from these power Bills. It seemed to him that Bristol wanted to reject the Bill in order that any reasonable conduct on their part, or any lapse of obligation in the way of affording a supply, might not be made good, and might be allowed to pass with impunity. He thought the Bath Corporation would find it difficult to keep up their supply at a high level, seeing the condition of their works from time to time. As to the objections of the water companies, the promoters were not desirous of giving any undue preference, and if that was not quite clear in the Bill they were perfectly ready to make it so. Regarding the danger from electrolysis, that was altogether illusory, and it need not be apprehended.

After deliberating in private, the CHAIRMAN said the Committee had decided not to exclude Bristol and Bath from the Bill. With regard to clauses, Clause 38 provided that every local authority of any borough or urban district, when they objected to a proposed line of route might have an alternative route or deviation, which in the opinion of the Board of Trade was reasonably practicable, and did not involve increased expense. The Committee thought those words involved a difficulty, and that the clause ought to read, "which in the opinion of the Board of Trade is reasonable, then such alternative route or deviation shall be adopted." Sub-section 2 of Clause 42 provided that the company should not supply energy for lighting purposes except to other authorised undertakers, provided that energy supplied to any person for power might be used by such person for lighting any premises in any part of which the power was utilised. They thought that involved a difficulty, for power might be taken for turning a lighting machine, and that might be used as an excuse for introducing a large lighting works, such as to light an hotel, where power was only given to be used for a lift or something of that kind. The Committee considered that opponents of the Bill ought to be protected from that, and that there ought to be some limitation, although they were not prepared to say exactly what the limitation should be. The motive power should at least be greater than that used for lighting purposes. They thought that Clause 54, giving the company power to take water from other sources than certain water companies appearing before them, should be allowed. Mr. Ram had handed in Clause 52 in the South Wales Act, for the protection of water companies from loss and damage which might occur to their mains and pipes by electrolytic or other causes, and they thought the companies ought to have that clause. Subject to those remarks they found the preamble of the Bill proved.

HOVE AND WORTHING TRAMWAYS BILL.

ON Thursday and Friday, May 7th and 8th, and Monday last, Lord Newton's Select Committee of the House of Lords considered the Tramways Bill of the Worthing Corporation, and the Hove, Worthing and District Tramways Bill of the British Electric Traction Co. Mr. E. Pollak, K.C., with Mr. E. Shortt, appeared for the Corporation, and Mr. H. Lloyd, K.C., Mr. Balfour Browne, K.C., Mr. Ernest Moon, K.C., and Mr. Hutchinson, K.C., for the Traction Co.

It was decided to take the Bill of the Worthing Corporation first; and Mr. POLLAK, in opening the case, after referring to the population of the borough, said that the Corporation was the electric lighting authority, and by using the current from the electric light generating plant for the purpose of tramway traction, they would be able to make their undertaking more profitable than if it were confined to the supply of light. There were five tramways proposed under the Bill, four of which were within the borough, and the fifth was intended to connect with South Lancing. The London and Brighton Railway Co. had recently acquired a considerable piece of land at Lancing for the purpose of erecting some new railway works, and the object of constructing the line to that place was to afford an easy means of communication with the large working-class district at the other end of the borough. The estimated cost of the tramways was £94,982, and they proposed at once to commence the work of construction in three cases at an estimated cost of £56,480. Under the Bill the Corporation were seeking for powers to carry out certain street improvements, and also to run omnibuses and motor-cars in connection with the trams. A poll was recently taken on the subject, when 2,186 were in favour of the tramways, and only 800 against, so he thought it was pretty clear that the inhabitants wished the Corporation to own the trams and not a foreign company who would only work them for their own benefit. Dealing with the opposition of the British Electric Traction Co., the learned counsel contended that they had no *locus standi* except with regard to the proposed extension to South Lancing, because in order to obtain the consent of the local road authorities for their own scheme, they had agreed with the West Sussex County Council that they would not take their trams into Worthing unless the Worthing Corporation failed to proceed with its own tramway Bill.

Alderman PIPER, of Worthing, in giving evidence in favour of the Bill, said that the Corporation had considered the question of tramways for the borough since 1901, and they were strongly of opinion that they were the proper body to have the control of them. On a poll, a large majority of the inhabitants had voted in favour of the Corporation proceeding with the present Bill. It was the intention of the Corporation to supplement the tramway service by a system of motor omnibuses in the narrow streets. With regard to the British Electric Traction Co.'s scheme, he considered that the proper position for a junction between the two systems was at South Lancing.

Cross-examined by Mr. LLOYD, the WITNESS said the Corporation did seriously mean to construct the tramways, and he would go as far as to say that he thought it would be in the interests of the town that the Traction Co. should have the right to continue their tramway into Worthing if the Corporation failed to construct theirs in a given time.

On the suggestion of the CHAIRMAN, an adjournment was made to see whether the parties could not come to an agreement, and on re-assembling counsel, announced that they had agreed on principle to the Worthing Bill, and the Committee would only have to consider the clauses.

Mr. LLOYD, K.C., opened the case of the British Electric Traction Co. for the Hove, Worthing and District Tramways Bill. He said that by the Bill his clients sought to obtain power to equip electrically the existing tramway from Hove to New Shoreham, and to construct a new line of tramway towards Worthing, and in the event of an agreement with Worthing, into the town itself. The result of those proposals would be that in place of the existing horse tramway between Hove and Shoreham, there would be a modern, well-equipped electrical tramway from Hove right through to Worthing. They had the support of all the local authorities eastward from Worthing until they got to Portslade, and here the Hove Corporation were apparently desirous of constructing tramways in their own area, and had proposed to bring in a Bill for the purpose. A meeting of ratepayers had, however, passed a resolution adverse to the Bill, and the question therefore arose whether, in view of the fact that they had been received with open arms by everybody from Worthing to Portslade, the old and antiquated horse tramway should be permitted to continue for the additional 1½ miles into Hove. Among the opponents to the Bill was the London and Brighton Railway, who said that the trams would compete with them; but he should ask the Committee to say that it was for the general convenience of the public that electric tramways should run in competition with railways. They served a different class of traffic. The company had agreed to give the Brighton and Hove Gas Co. clauses to meet possible damage from electrolysis.

Local evidence having been given in favour of the scheme, Mr. STEPHEN SELLON, the engineer, also gave evidence, and said that under the Bill there would be an up-to-date modern system of trams from Hove and right through to Worthing. The total length of the tramways now proposed was about 9 miles. There were no engineering difficulties in the way of the scheme. The gauge was the same as that of the Brighton tramway system, with which they hoped to ultimately connect. The estimated cost of construction was £55,335. They were asking for a term of 42 years, after which the Hove Corporation might buy up the undertaking on the basis of the Tramways Act.

Mr. BRUCE MORRISON, a member of the Hove Corporation, said that, provided the Corporation were sufficiently protected, he did not think they ought to take up a "dog-in-the-manger" policy, and prevent a private company from giving them the tramway communication which was urgently needed. Personally, if it were possible, he would like to see the Corporation construct the tramways, but there was strong opposition in certain quarters which he was afraid would mean the delay of the question for some time. They required through communication with Brighton; and although he had opposed the Traction Co. when it was a question of the Corporation constructing the tramways, he would back them up if the ratepayers would not allow the Council to proceed with their Bill.

After evidence from local residents in favour of the Bill, Mr. TALBOT addressed the Committee in opposition to the scheme on behalf of the Hove Town Council, who, he said, were of opinion that under the Bill their vested rights would be taken away without the slightest consideration.

Eventually the preambles of both Bills were found to have been proved.

London County Council Tramways.—The Select Committee of the House of Commons, under the chairmanship of Mr. Hudson Kearley, were on Wednesday, Thursday and Friday last week engaged in the consideration of the L.C.C. Tramways and Improvements Bill. Mr. M. Fitzmaurice, the engineer, was called and gave details as to the cost of the proposed tramways. The estimated total cost was £504,000. The Committee then conferred, and the Chairman announced that they had decided to sanction Tramways 3 and 4, subject to the Hammersmith Broadway being widened. The L.C.C. to bear two-thirds of the cost of widening, and the Borough Council the remaining one-third.

Wood Green U.D.C. Bill.—The Court of Referees have disallowed the *locus* of the North Metropolitan Electric Power Supply Co. to appear in opposition to this Bill.

Manchester Southern Tramways (Lancashire and Cheshire).—The Manchester Southern Tramways (Lancashire) Bill and the Manchester Southern Tramways (Cheshire) Bill came before Earl Lauderdale's Select Committee of the House of Lords on May 5th. The Bills, which will be amalgamated, incorporate a company to construct a number of tramways in the two counties. One tramway will be nearly five miles long, running from Sale to Palatine Bridge, and other lines run through Eccles, Davyhulme, Stretford and other places. Mr. Balfour Browne, K.C., who appeared for the promoters, stated that the promoters were negotiating with the opponents of the Bill, and it was hoped that the negotiations would lead to an amicable settlement. The real fight was between the promoters and the British Electric Traction Co., who were promoting the North Cheshire Tramways Bill. Mr. Pember, K.C., who represented the British Electric Traction Co., said there was a fair prospect of an agreement resulting from the negotiation and suggested that the matter be adjourned. After some discussion, it was decided to put the Bill at the end of the list before the Committee.

Sutton Coldfield Corporation Bill.—On May 4th Earl Lauderdale's Select Committee of the House of Lords considered this Bill, which was opposed by the London and North-Western Railway, in so far as the tramway portion was concerned. Counsel explained that the adjoining borough of Erdington obtained the sanction of Parliament last year to construct an electric tramway, and there would shortly be a continuous tramway from Birmingham to the northern edge of the district of Erdington, where the line would come to an unnatural stop if this Bill were not passed. There were rumours about that if the Corporation did not get power to run the tramway, the B.E.T. Co. would seek for powers, but he contended that the Corporation was the proper authority. The London and North-Western Railway Co. asked for clauses for their protection in respect to interference with their traffic by crossings, &c., which the Corporation were quite willing to give. The company also complained that the proposed tramway would run parallel to their Sutton Coldfield branch, which already, they said, afforded adequate accommodation for the traffic—a proposition which the Corporation denied. The proposed tram line would have a 3 ft. 6 in. gauge, and its entire length from the junction with the Erdington tramways to Watford Gap, would be 5¼ miles. There was also a short branch line running in a loop between Sutton Park and Erdington, but it was not proposed to construct that portion immediately. It was the view of the Corporation that they should be the tramway authority, and they asked for seven years in which to construct the lines, according as they thought they were needed. At first it was intended to make the line a double one, but by arrangement with the Warwickshire County Council it had been decided only to make a single line for the present, which would reduce the cost of construction by nearly one half. The promoters had no wish to interfere with the railway company, and if it would meet their views the Corporation would be willing to omit the portion of the tramway from Mere Green to Watford Gap. Mr. W. Clarry, the borough surveyor of Sutton Coldfield, gave evidence in support of the Bill. He explained that it was the intention of the Corporation to extend the electric lighting plant for the purposes of electric traction. Cross-examined by Mr. Forbes Lancaster for the London and North-Western Railway, the witness said he could not admit that the line was more in the nature of a light railway than a tramway. It was true that powers were sought to carry animals, goods, and timber; but the line was essentially for passenger traffic. Mr. W. C. Hawtayne, consulting electrical engineer, said he had assisted in preparing the plans for the proposed tramway. He estimated they would give the Corporation a profit of £2,000 a year. After local evidence in favour of the Bill, evidence in opposition was given on behalf of the London and North-Western Railway by Sir Frederick Harrison, the general manager. Eventually the Committee declared the preamble of the Bill proved, on the understanding that the tramway shall stop at Mere Green, and that only packages of less weight than 28 lbs. shall be carried by it.

Hastings Electric Tramways.—On May 6th and 7th a Select Committee of the House of Lords, presided over by Lord Newton, considered the Hastings Tramways Bill. Mr. Stephens, K.C., in opening the case for the promoters, said that by the Bill power was sought to construct a tramway along the front at Hastings. Practically the only opposition came from a body of ratepayers who had formed themselves into a committee to oppose the Bill, on the ground, as they alleged, that if the tramways were laid along the front it would be disastrous to the town, as doctors would refuse to recommend Hastings and St. Leonards as health resorts. Mr. B. F. Meadows, the town clerk, gave evidence in favour of the Bill, on behalf of the Corporation, which he said was favourable to the proposed trams. Evidence was also given by Councillor Handen and Mr. E. Howard (Mayor of Bexhill), the latter saying he favoured the Bill in the interests of the town, for inter-communication would be effected with Hastings when the Bexhill Light Railway was joined on. Mr. Waller, consulting engineer to the scheme, explained the details of the proposed extension, which he said exhibited no engineering difficulties. He knew several towns where tramways ran along the sea front, but there had not been any deterioration in the value of property. Personally, if it were possible, he would prefer to see the conduit system along the proposed route. Mr. Murphy said that, on behalf of himself and the other promoters, he would give an undertaking not to proceed with the trams along the front until they had first completed the lines already authorised. Local evidence against the scheme was then given, several witnesses being called, who gave it as their decided opinion that it would be highly detrimental to the town if trams were run along the sea-front as proposed. After hearing counsel for and against the Bill, the Chairman said that the Committee found the preamble of the Bill proved, provided that the extension was not proceeded with until the lines already authorised had been completed and opened for traffic.

London United Tramways Bill.—This Bill came before a Select Committee of the House of Commons on May 5th, presided over by Mr. Hudson Kearley. Mr. E. Charteris, who appeared for the promoters, in opening the case, said that under the Bill the London United Tramways Co. sought to acquire additional land in the counties of Middlesex, Surrey and London in order to effect certain widenings and alterations of roads, necessary to carry out powers obtained under previous Acts, and to fulfil obligations to various local authorities. One of the provisions of the Bill referred to the widening of the bridges at Hampton Court and Kingston. By its Act of 1901 the company was authorised to run tramways over those bridges, and it was provided that in the event of it being necessary to widen the bridges, the expense should be borne partly by the local authorities and partly by the company. In the present Bill it was proposed that if the bridge authorities raised a loan for the purpose, the repayment should be extended over a period of 60 years instead of 30 years as provided by the Local Government Act of 1888. The Local Government Board had taken exception to the proposal, but it had been accepted by the two Councils concerned as just, and there was a precedent for the extension in the Kew Bridge Act of 1898. There was no opposition to the Bill other than that of the Local Government Board. After hearing evidence from Mr. Bigwood, M.P., chairman of the Light Railways Committee of the Middlesex County Council, and Mr. Clifton Robinson, the managing director and engineer to the London United Electric Tramway Co., as to the necessity for the widening of the bridges, the Committee declared the preamble of the Bill proved.

Scottish Central Electric Power Bill.—This Bill which, under the Scottish Private Legislation Act, was deposited during the Easter recess, came before Mr. Jeune, Examiner, on Friday, for proof of compliance with Standing Orders. Satisfactory proof was given, and the Bill will accordingly go through the usual procedure provided by the Act.

Dumbarton Tramways Bill.—This measure, which is a proposal to allow the Electric Supply Corporation, Ltd., to construct and maintain tramways in the Burgh of Dumbarton, was before Mr. Jeune on Friday, when it was found that Standing Orders had not been complied with, and the matter will have to go before the Standing Orders Committee.

Electric Lighting Provisional Order (No. 1) Bill.—This Bill, which refers to Mitchelson in the county of Cork, came before the Deputy Chairman as an unopposed measure on Thursday last week, and was ordered to proceed.

Electric Lighting Provisional Order (No. 2) Bill.—On Thursday last week this Bill was before the Unopposed Committee of the House of Commons, and was ordered to go forward for third reading. The Bill confirms orders granted by the Board of Trade in respect of Brixham, Brumby and Frodingham, Dawlish, Horbury, Hucknell-under-Huthwaite, Newton-in-Makerfield, Orrell, Scunthorpe, Sidmouth, and Yeovil.

Electric Lighting Orders (No. 4) Bill.—This Bill, which confirms Provisional Orders granted by the Board of Trade, came before Mr. Campion for proof of compliance with Standing Orders on Friday last, and was ordered to go to second reading. The following orders are dealt with:—*Borrowstounness.*—Orders granted to the Provost and magistrates in respect of the Burgh of Borrowstounness in the County of Linlithgow. *Cambuslang.*—Order granted to the County Council of Lanark in respect of the special lighting district of Cambuslang in the Parish of Cambuslang. *Irvine.*—Grant to the Provost and magistrates of the Burgh of Irvine in the the County of Ayr. *Kilmalcolm.*—Order granted to the Kilmalcolm Electric Lighting Co., Ltd., in respect of the burgh and parish of Kilmalcolm in the County of Renfrew. *Kirkintilloch.*—Order granted to the Provost and magistrates of the Burgh of Kirkintilloch in the County of Dumbarton.

Electric Light Provisional Order (No. 3) Bill.—On May 7th the above Bill came before the Chairman of Ways and Means, and the preamble was declared proved. The Bill confirms provisional orders granted by the Board of Trade in respect of Auckland (rural), Carisbrooke and Northwood, Drayton-in-Hales, Illogen, Ingleton, Port Dinorwic, Sevenoaks, South Shields (rural), Stafford (rural) and Wilmslow.

Electric Lighting Provisional Orders (No. 6).—On May 5th Electric Lighting Provisional Orders (No. 6) Bill, which confirms a number of provisional orders, came before the Examiner, and Standing Orders were found to have been complied with. The orders related to the following districts:—Bexley (East Wickham), Bridgewater and District, Bromley Rural District (Kent Electric Power Syndicate), Hendon, Huddersfield (Urban District of Linthwaite); Leatherhead and District (Feltham, Leatherhead and District Electricity Co.), Prestwich, Stroud, Whitchurch and Pangbourne (Whitchurch and Pangbourne Electric Supply Co).

Cleveland and Durham County Electric Power Bill.—Further Standing Orders were found to have been complied with in respect to this Bill by Mr. Jeune on Friday last.

Cheshire Lines Committee Bill.—On May 7th this Bill, authorising the Committee to make a new line near Liverpool, was declared proved and ordered to go forward. It was announced by Sir Chandos Leigh that the powers asked for to run over the Liverpool Overhead Electric Railway had been struck out.

Fife Electric Power Bill.—On 7th inst. the Fife Electric Power Bill came before the Select Committee of the House of Lords, presided over by Lord Glenesk, when it was stated that opposition had been withdrawn, and the Bill will go forward as an unopposed measure. The Bill incorporates a company with a capital of £600,000, to erect four generating stations to supply the County of Fife with electricity for power purposes.

Airdrie and Coatbridge Tramways Bill.—This Bill came before Mr. Jeune, Examiner, on Friday, and Standing Orders were found to have been complied with. Further proceedings in connection with the Bill will be local.

Nottinghamshire and Derbyshire Tramways Bill.—This Bill came before a Select Committee of the House of Lords on Monday last, presided over by the Earl of Lauderdale. Mr. Balfour Browne, K.C., who appeared for the promoters, in opening the case, said he was glad to say that they had come to a satisfactory arrangement with their opponents which would considerably shorten the matter. His clients had sacrificed some of the tramways which they proposed originally to apply for, and, on the other hand, their opponents had agreed to their making the line they now sought. The first proposal was to connect Nottingham with Derbyshire, and to go north to Belper, thence to Alfreton, and to connect up with existing authorised lines at Mansfield. Owing to the threatened opposition of the Midland Railway Co., they had given up the idea of going to Derby. The present proposal sought powers to make a line from Nottingham to Alfreton, from Belper to Alfreton, and on the north to Mansfield. In addition to those main lines they were seeking powers to construct certain lines, partly in and partly outside the borough of Nottingham. There was now no opposition to any part of the scheme. After hearing formal evidence in favour of the Bill, the Committee declared the preamble proved.

CORRESPONDENCE.

Motor-Driven Pumps for Town Water Supply.

Seeing in this week's issue of the ELECTRICAL REVIEW that a correspondent would be glad to hear of any large electric motor-driven pumps installed at waterworks in this country for town water supply, I herewith enclose a few particulars relating to the same as used by this Corporation, which I trust will be of some service to your correspondent :—

Motor, one 50 B.H.P. ; worm gear, 18 to 1 ratio ; pumps, 18 in. by 12 in. (three-throw) ; capacity, 22 gallons per revolution ; speed, 26 revolutions per minute (average) ; pressure on gauge fixed on pump barrels 155 ft. head ; 14 ft. from suction valve to water ; average length of working hours, eight to nine hours per day.

L. Paton Greig.

Corporation Electricity Works,
Bury St. Edmund's.
May 9th, 1903.

Tests on Extra High-Tension Fuse.

Re Messrs. Witting Bros.' letter in your last week's issue, I shall be pleased, subject to the permission of the Metropolitan Electric Supply Co., to carry out the test proposed by Mr. Eborall. Messrs. Ferranti, Ltd., will take all responsibility in connection with the switchboard.

I would, however, point out that under working conditions there are two fuses in circuit when two machines are put into parallel out of phase, viz., one on each machine. This likewise applies to a motor at the end of a long cable line, there being one in the motor circuit, and one on the feeder. The switchgear, which is being installed at Willesden, is on this plan. If the Metropolitan Electric Supply Co. will allow it, we shall short-circuit the fuse on one machine so as to make the test more severe.

Charles C. Garrard.

Manchester, *May 12th*, 1903.

Football Results.

I noticed the paragraph which appeared in your issue of the 8th inst., headed "Football," referring to Messrs. Glover's team winning the Broughton Rangers' Cup, and also to their claim as being "the Rugby football champions of the Manchester workshops." This seems to me to be somewhat misleading, as Messrs. Glover's team also took part in the Swinton workshops competition, but were beaten in the preliminary stages, the Chloride Accumulator Works team eventually winning the cup for the second year in succession. It may interest you to know that the final in this competition was played between Irlam's Soap Works and the Chloride team, the latter winning by three points to two ; but earlier in the competition Irlam's Soap Works had beaten Glover's team by 15 points to five. I certainly fail to see that Glover's men have any claim whatever to the title of "champions." I may say that I am communicating with their secretary, and hope to arrange a match with them.

William Kenyon,
Secretary, Chloride Club.

Clifton Junction, *May 12th*, 1903.

BUSINESS NOTES.

Electrical Wares Exported.

WEEK ENDING MAY 13TH, 1902.		WEEK ENDING MAY 12TH, 1903.	
Alexandria	Value £42	Accra. Teleg. mat. ..	Value £70
Amsterdam	102	Alexandria. Teleg. cable ..	247
Bombay	98	Amsterdam	205
Boulogne	65	Auckland	150
,, Teleg. instruments ..	800	Bangkok	26
Calcutta	1,233	Bombay	386
,, Teleg. wire	130	Buenos Ayres. Teleph. mat. ..	216
Cape Town	824	Calcutta	543
Colombo	103	Cape Town	992
Copenhagen	87	,, Teleg. mat. ..	1,476
,, Teleg. wire ..	42	Colombo	17
Delagoa Bay	508	Copenhagen	99
Durban	1,133	Demerara	120
East London	790	Durban	817
Gibraltar	22	,, ...	2,829
Gothenburg	11	East London	204
Hamburg	209	Gibraltar	138
Lyttleton	20	Hamburg. Teleg. mat.	250
Madras	30	Kong Kong	18
Melbourne	445	Lisbon. Teleph. cable	1,252
Perth	420	Lyttleton	14
Port Elizabeth	58	Madras	188
Shanghai	303	Malta	12
Singapore	290	Melbourne	565
Stockholm. Teleph. cable ..	196	North Atlantic. Teleg. cable	6,000
Wellington	425	Oporto. Teleph cable	50
Yokohama	520	Perth	411
		Port Elizabeth	118
		,, Teleg. mat. ..	345
		Port Said	52
		Shanghai	815
		Sierra Leone	20
		Singapore	12
		,, Teleg. mat.	101
		Sydney	849
		Wellington. Teleg. mat. ..	1,081
		Yokohama	697
Total ..	£8,910	Total ..	£21,325

Foreign Goods Transhipped.

New York. Elec. mat.	Value £480	Cape Town. Telph. mat.	Value £2,317
		Oporto. Teleph. mat.	50
		Total ..	£2,367

Fire.—The International Fire Exhibition was opened at Earl's Court last week, as recorded in the daily papers. There is much in the various exhibits that will interest the electrical engineer, and we shall refer again to these in due course. To intending visitors we might mention that in the German Court the following exhibits are worth inspection :—

36. Schwabe & Co.—Electric lighting in emergency, system "Giersberg" ; fireproof lighting for shops, &c.
37. Oscar Schöppe.—Fire alarms, system "Schöppe."
38 Siemens & Halske.—Fire alarms and telegraphic appliances.

In the Queen's Palace the chief electrical exhibits are :—

53. Bergmann Electrical Works.—Enclosed motors, conduit systems, &c.
54. Pearson Fire Alarm Co.
55. J. E. Spagnoletti & Co.—Alarm bells and indicators, &c.
63. P. Hensel & Co.—Thermostatic temperature recorders, batteries, &c.
72. May-Oatway Fire Appliances, Ltd.—A fire station watch room completely equipped.
76. Liemes Electrical Appliances Co., Ltd.—Fire alarms, &c.
79. General Electric Co., Ltd.—Telephonic fire brigade alarm system ; conduits, fittings, &c., for fire prevention.
80. The Synchronome Co.—Electric clock control.
82. The Simplex Steel Conduit Co., Ltd.
83. James Pitkin & Co.—Recording pyrometer.

In the Imperial Court :—

133. Stuart & Moore.—Fire telegraphic apparatus, alarms, telephones, &c.
145. Merryweather & Sons, Ltd.—Hatfield electric pump, &c.

Advance in Rubber Prices.—In consequence of the continued increase in price of crude rubber and other materials, the North British Rubber Co. announces an advance of 10 per cent. on all mechanical rubber goods, including packings, belting and hose.

Electrical Progress in Spain.—Consul Macdonald, in his report on the trade of the Bilbao consular district for the year 1902, states that a tendency has arisen to employ gas engines with producer gas, for which the native anthracite coal is very suitable; but it is certain, he thinks, that when various plans are realised for supplying Bilbao with electrical power derived from waterfalls near Miranda and in Guipuzcoa, industries generally will declare in favour of electrical machinery. The Hidro-Electrica Iberica Co. made contracts in 1902 for the supply to various firms of electrical energy amounting to 3,400 H.P., and the company hopes to be in a position to furnish this during the present month (May). Applications for the further supply of 7,810 H.P. were also received. The falls in the Ebro and Leizaran Rivers, over which the company has acquired rights, are estimated to supply up to 16,000 H.P., an amount which can be consumed in Bilbao. The installation of the transforming plant to that extent is being put in hand. Contracts for the supply of power were made at the following rates:—

Horse-power	No. of hours per day.	Price per annum per horse-power.		Conditions.
		Currency.	Sterling.	
		Pesetas.	£ s. d.	
150	12	150	4 7 9	Hours at supplier's option.
500	12	200	5 16 11	Hours at consumer's option.
200*	12	200	5 16 11	Ditto.
150*	12	150	4 7 9	Hours at supplier's option.
400	24	250	7 6 2	

* Contracted with same firm.

An important item of the present importation into Spain consists of incandescent electric light bulbs, of which 224,806 appear in the import returns for 1902, an increase as compared with 1901, of 186,777 bulbs. These were all of German origin. The most usual numbers are from 5 to 25 candles. The wholesale price, f.o.b., was 35 fr. (£1 8s.) per 100 bulbs, the customs duty payable thereon being 20 pesetas (11s. 8d.). Native manufacturers of incandescent bulbs, of whom there are several, Mr. Macdonald states, do not yet produce an article of first-rate quality, but they will probably improve, as electricity has taken firm hold in Spain. Retail prices for native bulbs are from 70 to 75 pesetas (£2 1s. to £2 4s.) per 100. The Germans have also taken a firm hold of the trade in electrical appliances, and, owing principally to the resources and enterprise of a well-capitalised company in Bilbao, have secured something like a monopoly of all large installations. Government statistics issued for 1901 show that in that year the provinces of Biscay, Guipuzcoa, and Old Castile possessed 160 factories and workshops with 293 generators, developing power to the amount of 13,932 KW. An electric tramway nearly 22 miles in length, was opened from Bilbao to Durango with a branch of nine miles from Lemona to Ceanuri. Power is derived from two waterfalls near Durango. The machinery and electrical installation were supplied by the Thomson-Houston Co., of Paris. The turbines were purchased from the United States of America. The rolling stock consists at present of seven 39 ft. bogie cars, six cars of 26 ft., and four goods trucks, all built at Zaragoza (Spain), the wheels, springs, and other parts being bought in the United States. Five more cars have been ordered from Zaragoza, and 20 are to be built in Bilbao.

A Watch for Engineers. — The Scientific Publishing Co., of Manchester, has put on the market what is termed "The Mechanical Engineer" non-magnetic keyless lever chronograph. It has been specially designed to meet the wants of engineers generally. For testing and time-recording purposes, and for electrical engineers in charge of electrical machinery, it should prove specially useful, as the works are said to be thoroughly non-magnetic, of the latest design, full-jewelled and superfinished, and are enclosed in a strong steel oxidised case. The watch is a real chronograph, and not merely a stop-watch, the ordinary time-recording mechanism being entirely independent of the chronograph action. We purchased one of these about a week ago, and, so far as we can judge in the short time we have used it, the advantages claimed seem to be fully justified.

Edwards Air Pumps. — These well-known pumps are to be fitted to condensing plants for the following electrical installations:—Stalybridge, Hove, Pontypridd, Radcliffe, Wallasey, York, Barnstaple, Bexley and Gibraltar; also to the following stations under repeat orders, viz., Bournemouth, Bristol, Sunderland and Newcastle-on-Tyne.

Meters for Sale.—The Brighton Electricity Department is offering 124 Ferranti, 84 Hookham, 22 Aron, and 13 Shallenberger meters for sale.

A Manchester Directory.—We have received a copy of a "Directory and Guide to the Manchester Royal Exchange" for 1903 (price 7s. 6d.). It is the eighth edition of the work, and its proprietor and compiler is Mr. Richard Collinson, of 9, Corporation Street, Manchester. Its principal usefulness lies in the fact that it is a well-arranged directory of, we suppose, the major part of the business world of Manchester. The exchange has 8,063 members, representing 4,760 firms. The telephone numbers are brought out very prominently; in addition to the alphabetical section there is a classified trades section. It is quite unnecessary to say anything here respecting the importance which Manchester has assumed as an electrical and engineering trades' centre—everyone is familiar with the fact; but it is necessary for such a district to have a representative directory, which this one seems to be.

Dissolutions and Liquidations.—*Re* H. M. Salmony and Co., Ltd.—The winding-up order against this company which carried on the business of electrical apparatus merchants at Charing Cross Road, W.C., was made on March 3rd last upon the petition of creditors. The summary of the statement of affairs, together with his observations upon the history of the company, have now been issued to the creditors and shareholders by Mr. G. S. Barnes, senior official receiver and liquidator. The accounts show assets £248 16s. 8d. absorbed by the claims of the debenture bond holders, which amount to £1,446 13s. 4d. In addition to those claims, there are unsecured debts £1,071 1s 7d., fully secured debts £484 18s. 7d., the securities being valued at the same amount, and a partly secured debt of £487 15s. 6d., the creditor holding security to the value of £170. The deficiency to the creditors is returned at £2,586 13s. 9d., and the account with the contributories discloses a total deficiency of £19,586 13s. 9d., which is accounted for as follows:—

Excess of capital and liabilities over assets on March 31st, 1900, being losses incurred to that date			£8,805 7 5
Expenses of carrying on business from April 1st, 1900, viz.:—			
Salaries and wages	£2,382 8 1		
Rent, rates and taxes	323 15 9		
Miscellaneous trade expenses	1,591 6 9		
Interest on loans	665 5 6		
		4,961 16 1	
Bad debts		878 16 2	
Depreciation not written off in company's books, viz.:—			
Fixtures and furniture	£278 7 3		
Goodwill	14,257 0 3		
		14,535 7 6	
E. Rosenberg's indebtedness written off in accordance with agreement of June 19th, 1902		2,829 8 1	
Depreciation on stock from April 1st, 1900, to March 3rd, 1903		776 4 0	
			£32,786 19 3
Less:—			
Profit on sale of lease as per books of account	£520 0 0		
Creditors not expected to rank	331 6 9		
Liabilities extinguished under agreement of January 29th, 1902:—			
Debentures	£4,500 0 0		
Interest on debentures	438 0 0		
Sundry creditors	7,410 18 9		
	12,348 18 9		
		13,200 5 6	
Deficiency as per statement of affairs			£19,586 13 9

According to the observations of the Official Receiver, the company was registered on March 16th, 1898, to acquire and carry on the business formerly owned by Henry Max Salmony and Ernest Rosenberg. The nominal capital was £25,000, divided into 5,000 5 per cent. cumulative preference and 20,000 ordinary shares of £1 each. The first directors were Henry Max Salmony, Ernest Rosenberg, and Hermann Schwabe; but there were several changes in the constitution of the board, and at the date of the liquidation the directors were Messrs. Wells, Heath, Dott and Bate. According to the articles of association the qualification of a director was the holding of debentures to the value of £250, or shares in the company of the nominal amount of £100. H. M. Salmony does not appear to have qualified. Major MacMahon and J. Lewenz acted from March to November, 1898, without qualifying, and then had the necessary qualification shares transferred to them by Ernest Rosenberg (one of the vendors) in accordance with a resolution passed at an extraordinary general meeting of the company held on November 11th, 1898, authorising any past and present directors of the company to receive their qualification shares from the vendors without liability on their part to account to the company. The other directors were duly qualified. The remuneration of the directors was not fixed by the articles of association, but they were to receive such sums and in such proportions as the company in general meeting might from time to time determine. No remuneration has been voted to the directors at any of the general meetings, although a sum of £132 10s. 6d. has been paid in respect of directors' fees. On March 28th, 1898, H. M. Salmony and Ernest Rosenberg were appointed joint managing directors for five years from January 1st, 1898, the salary payable to each being £250 per annum. The purchase contract is dated March 28th, 1898, and was entered into between the vendors, Henry Max Salmony and Ernest Rosenberg, lately carrying on business as H. M. Salmony & Co., and the company. It provided for the sale to the company as from January 1st, 1898, of the vendors' business, as a going concern, together with all goodwill, patents, trade marks, fixtures, plant, machinery, &c., lease of premises at 118 and 120, Charing Cross Road, and all book and other debts due to the vendors, subject to payment thereout of debts and liabilities of vendors in connection with the business. The consideration was fixed at £19,000, payable as to £7 in cash, as to £11,993 by the allotment of 11,993 fully paid ordinary shares, as to £5,000 by the allotment of 5,00 fully paid preference shares, and the balance of £2,000 in cash or debentures, at the option of the company. In order to secure the necessary working capital the contract provided that the vendors should subscribe for, or procure the subscription by responsible persons on or before May 1st, 1898, of shares or debentures to the amount of £8,000 in the following proportions:—H. M. Salmony £1,000 and Ernest Rosenberg £7,000. It was also agreed that the company should defray all expenses incidental to its formation. On March 28th, 1898, a resolution was passed by the board creating debentures to the extent of £10,000, and on the same date debentures to the extent of £6,000, were allotted for cash to applicants, procured by the vendors (£1,000 by H. M. Salmony and £5,000 by Ernest Rosenberg). Subsequently

the purchase was completed in accordance with the terms of the purchase contract, the vendors accepting debentures for £2,000 as part consideration, thus increasing the debentures to £8,000. The whole of the purchase consideration was paid to Ernest Rosenberg in accordance with the written request of H. M. Salmony. The total amount of debentures issued by the company, according to its register of debentures, is £7,900, since reduced by repayments to £5,900 On July 26th, 1898, both Salmony and Rosenberg resigned their positions as managing directors, C. Leven having previously been appointed general manager. Rosenberg, however, continued to act as director, and received his salary up to January 29th, 1902, the date he resigned his directorship. At a board meeting held on June 17th, 1899, the directors resolved that the best interests of the company would be served by disposing of the accessories and fittings portion of the company's business. It is understood that this resolution was passed in consequence of the large amount of stock of accessories, &c., on hand, and the heavy expenses which the management of that branch of the business entailed. On July 5th, 1899, an agreement was entered into with Rawlings Bros, of 82, Gloucester Road, S.W., for the sale to them of the accessories and fittings portion of the business. The consideration for the sale was based upon a valuation of the stock, &c., agreed upon between the parties, and the company received in respect of such sale between £7,000 and £8,000. The company also agreed to assign to the purchasers the lease of the premises 118 and 120, Charing Cross Road, and the purchasers agreed to grant the company an underlease of the second floor of such premises at a rent of £4 per annum for a term of 11¼ years. The purchasers also agreed to pay to the company in the event of the surrender of the underlease to them the sum of £100 per annum for each year the underlease had to run at the date of such surrender. In October, 1901, the company disposed of the lease for £410. Two balance-sheets were prepared on September 30th, 1899, and September 30th, 1900, respectively, and showed the following results:—

September 30th, 1899.	Net loss	£7,766	2 5
,, 1900.	,, ...	1,989	8 7
	Total net loss	£9,755	11 0

Notwithstanding that a considerable part of the company's business had been previously disposed of to Rawlings Bros., the goodwill was valued in each of the two balance-sheets at the amount which had originally been paid for it—viz., £14,257 0s. 3d. Owing to the unsatisfactory management of the business by Ernest Rosenberg, and as a result of negotiations on the part of Stephen S. Alcock, secretary to the company, and John E. Preston, also in the service of the company, an agreement was entered into on January 29th, 1902, between Ernest Rosenberg, Otto Rosenberg, Hermann Schwabe, Stephen S. Alcock, John E. Preston and the company, in which after reciting that Ernest Rosenberg had agreed to sell to Alcock and Preston the whole of his interest in the company for £1,500, and that he had transferred to them the whole of his shareholding and £4,500 out of £5,900 debentures held by Ernest Rosenberg, Otto Rosenberg and Hermann Schwabe in trust for Ernest Rosenberg and that £100 had been paid in part consideration of the purchase price, it was agreed as follows:—

1. That Ernest Rosenberg should release the company from all liability in respect of a debt of £4,500 due to him by the company as representative of his late father, a creditor for money lent.
2. That Ernest Rosenberg should release the company from all liability in respect of interest on debentures.
3. That Ernest Rosenberg and Hermann Schwabe should indemnify the company against all liability in respect of a debt of £3,600 due by the company to Messrs. Modera & Co., of Verviers, Belgium.
4. That Alcock and Preston should pay the balance of the purchase consideration by five instalments of £250 each and one of £150, the first of such instalments to be paid on June 20th, 1902, and that upon payment of each instalment an equivalent amount of the £1,400 debentures held by Ernest Rosenberg should be transferred to Alcock and Preston.
5. That Alcock and Preston should be appointed directors instead of the existing board, and that they should also indemnify Ernest Rosenberg, Otto Rosenberg and Hermann Schwabe against all claims in respect of scheduled debts due by the company.
6. That the commissions and moneys due to the company in respect of contracts with Lahmeyer & Co. were to be assigned to Hermann Schwabe.

The debentures for £4,500 transferred to Alcock and Preston were cancelled and the company released from all liability in respect of the same. Alcock and Preston constituted themselves managing directors, and on June 30th, 1902, fixed their remuneration as such at £350 each per annum. Further capital which it had been expected would be introduced was not forthcoming, owing, it is stated, to the previous mismanagement of the company's business by Ernest Rosenberg. The company, therefore, was without working capital, and in February, 1902, a sum of £225 was advanced to the company by a Mr. Conolly, he receiving as security goods to the value of £315. The loan has not been paid off, and it is understood that Mr. Conolly is gradually disposing of the goods. Goods to the extent of £170 were deposited with the Stewart Electrical Syndicate against the company's indebtedness to it, in consequence of the syndicate's refusal to execute further orders unless its account was to some extent satisfied. The value of the goods at present held by the syndicate is about £100. On May 16th, 1902, Ernest Rosenberg, Otto Rosenberg and Hermann Schwabe instituted proceedings for the appointment of a receiver on their behalf in respect of the debentures for £1,400 held by them in trust for Ernest Rosenberg, which security they alleged was in jeopardy, owing to the action of the company in disposing of its assets in the manner before mentioned. On May 23rd, 1902, an order was made by the Court restraining the company from disposing of its assets until the hearing of the motion fixed for May 27th, 1902, for the appointment of a receiver. On May 26th, 1902, the company issued a writ against Ernest Rosenberg for the recovery of a sum of £2,658 9s. 1d., £10 being in respect of loan made by the company, and £2,648 9s. 1d. alleged to be owing by him in respect of moneys overdrawn, which overdraft he denied. On June 19th, 1902, it was agreed between the parties that all proceedings should be stayed upon the following terms:—

1. That the debenture for £1,400 be transferred to the Stewart Electrical Syndicate in exchange for a debenture for £500 in that syndicate in favour of Hermann Schwabe.
2. That all claims of the company against Ernest Rosenberg be released.
3. That all the share capital of the company (with the exception of two shares) be transferred to the Stewart Electrical Syndicate, the consideration for such transfer to be £100 in fully-paid shares in the Stewart Electrical Syndicate, to be issued 60 shares to Ernest Rosenberg, 20 shares to Stephen S. Alcock, and 20 shares to John E. Preston.

It is not apparent what consideration the company received for releasing Rosenberg from his alleged indebtedness to the company, and the question as to whether the company is bound by such agreement is being considered. On July 10th, 1902, a general meeting of the company was held, when the directors and manager of the Stewart Electrical Syndicate were appointed directors of the company. Since that date the company's business has practically been carried on and managed by the Stewart Electrical Syndicate, and has resulted, according to the statement of the secretary, in a small profit being made. The failure of the company is attributed by the secretary to the mismanagement on the part of its former managing director, Ernest Rosenberg. The claims of secured creditors, £484 18s. 7d., appearing in the statement of affairs include a claim by creditors in Moscow in respect of commission and warehouse charges on goods consigned to Moscow, which the consignees refused to accept. In conclusion, Mr. Barnes reports that there does not at present appear to be any prospect of funds becoming available for the purpose of meeting the claims of the unsecured creditors.

The first meetings of creditors and contributories in the S. M. Van Hinden Electrical Co., are to be held on May 19th, at Liverpool.

Bankruptcy Proceedings.—Mr. James Philip Lemmon, practical electrical engineer and fitter, who has carried on business for some years at Canterbury Street, New Brompton, Chatham, has just filed his petition in bankruptcy at the Rochester County Court. His affairs, our local correspondent reports, are now in the hands of the Official Receiver for the district, Mr. R. T. Tatham.

Books Received.—"Mechanical Refrigeration," by Hal Williams. London: Whittaker & Co. 10s. 6d.

"Electrical Influence Machines," by John Gray. London: Whittaker & Co. 5s.

"Electrical Installations," by Rankin Kennedy. London: The Caxton Publishing Co. Price 9s.

"The Internal Wiring of Buildings," by H. M. Leaf. Westminster: Archibald Constable & Co., Ltd. Price 3s. 6d.

"Cornell University Register, 1902—3." Published by the University, at Ithaca, New York.

"The Elements of Electro-Chemistry treated Experimentally," by Dr. R. Lüpke. London: H. Grevel & Co. 7s. 6d.

Catalogues and Lists.—Messrs. Elliott Bros., of Leicester Square and Lewisham, have brought out a new illustrated catalogue of alternating current instruments which have been designed for use on single-phase and polyphase circuits. The list, which is of convenient size and shape, and is very fully illustrated both by means of small half-tone blocks and diagrams, contains details of both portable and switchboard types of instruments made under the Heap patents. The instruments shown include ammeters and voltmeters, wattmeters, power factor indicators, and one special feature to which attention is drawn is the fact that they can be used with perfect safety on high tension circuits, the instruments themselves being entirely insulated from the main circuit.

The British Schuckert Electric Co., of Clun House, W.C., has sent us a binding cover into which its descriptive pamphlets may be inserted as they are published from the press. Several pamphlets are already on file therein. No. 203 gives an account of the company's work at Lowson's Mills, at Arbroath, where a generating plant and lighting and motor installation were put in. No. 202 details the Schuckert surface contact tramway system; and No. 201 is devoted to an account of its continuous current generators.

From the Warren Ball-Bearing Fixture Co., of 377, Broadway, New York, we have received an illustrated list of the Fergusson ball-bearings as applied to electric light fixtures for desk and wall brackets, and show-case lighting. The principle is also applied to adjustable desk telephones, shaving mirrors, &c.

Messrs. Archibald Smith & Stevens, of Queen's Road, Battersea, have sent us a copy of their very neatly got-up brochure, giving some "Notes on Electric Lifts," and some well-executed art illustrations of their different styles of electrical lifts for passenger and goods service. The different methods of control and gearing are explained, and among other useful features we note a table showing comparatively the costs of working hydraulic and electric lifts now operating in different parts of the country. Needless to say, the "number of trips obtained per penny," which is the basis of comparison, shows a remarkable advantage for electrical working, the number of electrical trips being three or four times, and more, as great as the hydraulic.

Several new lists have been issued from the press this month by Messrs. Mather & Platt, Ltd., relating to their electrical machinery manufactures. We have received one which relates to their D-type dynamos for small outputs; it will form a companion to the firm's multi-polar list already in the hands of the trade. A second pamphlet, somewhat bulkier than the one just referred to, is their list of patent gravity and pressure filters; it has been entirely re-written, and much new matter added.

Trade Announcements.—In consequence of great increase in business in Manchester and the neighbourhood, the Electrical Co. has removed its offices and showrooms to larger premises at Grosvenor Chambers, 33, Blackfriars Street, Manchester.

On May 15th (to-day) certain important changes take place in connection with the house of Witting Bros., Electrical Engineers and Contractors, Ltd. Mr. A. C. Eborall, who has had the technical management of the business from its commencement, has now joined the firm, the style of which is altered to Witting, Eborall & Co., Ltd. It has also become necessary to have more commodious offices, and such have been taken at Temple Bar House, E.C. The firm's special feature is the carrying out of complete installations in connection with traction, power and lighting.

Mr. A. H. Sparkes has left Messrs. Braby & Tomlinson, Ltd., electric wiring contractors, of 15, Hart Street, Bloomsbury, and dating from May 1st, has joined Mr. W. F. Carter, trading as the Cross Electric Engineering and Manufacturing Co, at 17, Cross Street, Hatton Garden, E.C. The Cross Co. are manufacturing main and branch distribution boards, main switches, fuseboards and electrical accessories.

The Phœnix Dynamo Manufacturing Co. inform us that they have appointed as their agent for Birmingham district, Mr. H. W. W. Dix, whose headquarters are at 41, Church Street, Birmingham.

The office of the general manager of the Simplex Steel Conduit Co., Ltd., has been removed from 20, Bucklersbury, E.C., to larger and more convenient premises at Westinghouse Buildings, Strand, W.C. The company's London offices and stores will remain as at present, at Mansion House Chambers, 20, Bucklersbury, E.C.

Mr. James Gray, of 19, Waterloo Street, Glasgow, has ceased to represent the Berliner Telephone Manufacturing Co., and the company has made arrangements with Messrs. William McGeoch & Co., Ltd., of 108, Argyle Street, Glasgow, to represent it as sole agents for Scotland and Ulster for the sale of Berliner manufactures. Messrs. McGeoch now hold a very complete stock of these telephones and accessories.

Auction Sale.—On May 26th Messrs. P. Huddleston and Co. are to offer for sale by auction a quantity of engineering plant on the premises of the Consolidated Telephone Co., at Coventry. Some further particulars may be found in our advertisement pages to-day.

Superheating.—Further orders for Schmidt or Bolton superheaters have recently been booked by Messrs. Easton & Co., including plants for Messrs. Johnson & Phillips, Marshall, Sons and Co., Ltd., and the Bury Electricity Works.

ELECTRIC LIGHT AND POWER NOTES.

Arbroath.—The T.C. has had under consideration a report by the engineers on the lighting of the burgh by electricity. They recommend that the installation would be sufficiently large to warrant it having its own engineer and staff, as distinct from the gas department, and suggested that a separate Electric Lighting Committee should be appointed. The engineers gave approximate estimates of the minimum cost at three different sites, allowing for distributing mains only in the compulsory area, but keeping feeders and plant of such a size as to form part of a permanently extended scheme afterwards. The costs were £16,950, £17,130 and £16,330 respectively. They estimated the gross revenue at £1,964 for 18 arc lamps and 5,000 private lamps, but recommended that the system be extended outside the compulsory area from the commencement. The Council deferred consideration of the question whether they should carry out the work themselves or hand it over to a company, until they had received all the offers from private companies.

Auckland.—The Durham County Electric Power Co. has been granted a prov. order to supply energy to the district.

Birmingham.—The E.L. Committee has recommended the following reduced scale of charges:—Lighting: for the first 300 units per quarter, from 7d. to 6d. per unit; beyond, from 4½d. to 4d. For power and day load lighting: the first 300 units per quarter, 3d. per unit as against 4d. for the first 100 units; up to 3,000 units, 2d., and beyond, 1½d., against 2d. per unit over 100 units. Meter charges have also been reduced to 2s. 6d. per quarter up to 5 amperes, 3s. up to 25, and 5s. up to 100.

Bramley.—Owing to the objections raised by the L.G.B., the Board of Guardians has decided to withdraw its scheme of electric lighting at the workhouse.

Caerphilly.—The T.C., being dissatisfied with the refusal of the B. of T. to grant an E.L. order, has decided to ask for a copy of the Commissioner's report showing the reason for the refusal.

Cambridge.—The B. of T. has granted to the Cambridge and District Electric Lighting Co., Ltd., a prov. order authorising them to supply electrical energy for public and private purposes to the Parishes of Cherryhinton, Coton, Fen Ditton, Girton, Grantchester, Great Shelford, Histon, Impington, Trumpington and and Chesterton.

Canterbury.—During the past four years the accounts have shown a net profit on the electricity undertaking of £1,059. Last year, owing to extra expense, there was a deficit of £51.

Carlisle.—The T.C. has received from the L.G.B. sanction to borrow £24,000 for E.L. extensions, and additional plant for tramway purposes.

Chippenham.—The T.C. has decided to call in an expert to advise on the question of electric lighting.

Clacton-on-Sea.—The L.G.B. has sanctioned the raising of a loan of £15,225 for E.L. purposes.

The Council has decided by seven votes to six, not to apply to the B. of T. for the period in which to carry out the order to be extended for five years.

Colne.—At a meeting of the T.C. on May 6th it was reported that there had been a loss of £1,300 on the electricity department during the year.

Consett.—It was reported at the meeting of the U.D.C. on 7th inst., that the Durham and Cleveland Electric Power Co. were about to erect electricity works in the district.

Conway.—A private company has approached the T.C. respecting the establishment of electric lighting works in the town. The surveyor is to make a full report on the subject.

Croydon.—Owners of property adjoining the Electricity Works have given notice of an action in respect to the spray from the cooling pond. The Corporation intends to defend the action.

The E.L. Committee has also decided to oppose the Bill being promoted in Parliament by the Crystal Palace and Dulwich Gas Co., with a view to obtaining an amendment of the Bill.

Dawlish.—The U.D.C. has signed a modified agreement with Messrs. Crompton & Co., for the establishment of electric light works in the town. Instead of having the option of purchase at stated periods, the U.D.C. will be able to give notice to terminate the agreement at any time.

Derby.—The T.C. has adopted the report of the E.L. Committee and agreed to the expenditure of £33,400 for extensions of generating plant and mains, and for the provision of generating machinery for the proposed tramways.

Dudley.—The output of the E.L. undertaking for the past year has been 1,301,768 units, an increase of 334,387 units, as compared with the previous year. The gross profit on the year's working is £4,526, and after deducting £3,319 for financial charges there remains a net balance of £1,207.

Dundee.—Mr. H. Richardson, the city electrical engineer, has been instructed to obtain estimates for oil filters for the boilers. At the last Committee meeting he reported on the extension of mains in the central area of the city, and recommended that the whole of the rubber distributors and iron pipes should be taken up and replaced by stoneware conduits with new cable, at a cost of £9,843. This was approved, the cost to be spread over a number of years, as the Finance Committee may direct. Mr. Richardson's proposals respecting certain minor alterations to the traction switchboard were also approved.

Gorton.—The U.D.C. has been informed that the Manchester Corporation is not prepared to take a lease of the Gorton prov. order on the terms offered, but the Electricity Committee is willing to consider the question of supplying the district with electricity in bulk.

Grantham.—Supply was switched on at the Urban Electric Supply Co.'s works for the first time on May 2nd. Electricity is at present being supplied free from dusk till 11 p.m.

Gravesend.—A L.G.B. inquiry into the application of the T.C. for a loan of £12,544 for electric lighting and refuse destructor purposes was held last week. The only opposition was with regard to the discrepancy between the estimates of work already carried out and the actual expenditure, viz., £35,000 and £50,000 respectively.

Grimsby.—Application has been made by the T.C. for a loan of £7,000 for E L. purposes, and extensions to the plant at the works.

Hull.—The L.G.B. has sanctioned the borrowing of £24,000 for electric lighting purposes.

Kingston.—The extension of street lighting with "Gilbert" 6-ft. carbon arc lamps of a similar pattern to those used in lighting the Thames Embankment has just been completed, and the river front, Kingston Hill, and several other parts of the town are now lighted by these lamps, which are run at 1,100 volts (direct current), and burn nearly 70 hours without re-trimming. A novel feature of the new installation is the Gilbert patent switch, by means of which incandescent lamps are automatically switched on and off as required by means of the arc lamp circuit.

Leigh.—The engineer has reported on the necessity for extensions in the near future:—"The total cost of the works is estimated at £4,058 12s., borrowing powers for which have already been obtained. New mains are put down at £93› 7s. 6d.; surface condenser and oil separator, £830; cooling tower, £780; water-tube boiler, foundations and steam pipe, £1,150; set of balancers and switching apparatus, £170." The report has been referred to a Sub-Committee, as was another report on the advisability of making a reduction in the prices charged for electricity used for lighting purposes.

Llanelly.—Satisfactory arrangements have been arrived at between the T.C. and the Carmarthenshire Electric Power Co. whereby opposition to the company's Bill will be dropped.

Llangollen.—The U.D.C. is considering "in camera" an electric light scheme for the town under the prov. order obtained 18 months ago.

London.—Marylebone.—The Electric Supply Committee has had under consideration counsel's opinion as to whether the L.C.C. would be justified in refusing to sanction the borrowing of the sum awarded by the umpire for the purchase of the Marylebone business of the Metropolitan Electric Supply Co., Ltd., and if, in the opinion of the counsel, the County Council were so justified, what was the best course to pursue. Mr. Asquith advised, in the first instance, the writing of a letter to the L.C.C., the terms of which he suggested. This was agreed to, and the town clerk was instructed accordingly. A motion was adopted that no information be given the Press as to the legal opinions, until the County Council's reply had been received.

Maesteg.—The B. of T. has granted a prov. order to the U.D.C. for electric lighting.

Maidstone.—The T.C. has applied for a loan of £7,100 for electric lighting purposes, principally for the extension of mains.

The accounts of the electricity department for the past year show a net profit of £50.

Mansfield.—The official opening of the electricity works has been fixed for June 17th.

Middlesbrough.—The annual report of the borough electrical engineer (Mr. Taylor) states that the gross profits of the electricity works were £3,265 19s. 2d., an increase of £1,164 16s. 9d. on the previous year.

The price of energy for power has been fixed at 2d. per unit for the first 50 hours per quarter, and 1d. per unit afterwards.

Newport.—The T.C. intends to apply for sanction to raise a loan for proposed extensions of the arc lighting system, and for an installation of motors at their Llanarth Street works.

Oxford.—On the occasion of two dramatic performances given at the Town Hall, Oxford, on 5th inst., for charitable purposes, the stage lights, incandescent and arc, were installed by Messrs. B. H. Rolfe, M.A., and Fred. B. Joseph, the various apparatus being kindly lent for the occasion by Messrs. Verity, The Imperial Lighting Co., and Messrs. Chard & Co.

Reading.—The local Electric Supply Co. has offered to deliver electricity in bulk to the T.C. at a pressure of 400 volts for arc lighting, on the principal tramway routes, from dusk to dawn at 1¾d. per unit, and from dusk to midnight at 2¼d.

Russia.—At the commencement of the present year La Société d'Eclairage Electrique de St. Petersburg was supplying current to 376 arc lamps for public lighting, equivalent to 6,450 10-c.p. lamps, and for private lighting purposes to an equivalent of 233,594 10-c.p. lamps. The balance-sheet, as a result of last year's operations, shows a profit of £56,335.

Salisbury.—The Board of Guardians has asked the local Electric Light Co. to quote for lighting the Workhouse with electricity for a term of five years.

Shrewsbury.—At a meeting of the T.C. it was announced that the electrical undertaking was progressing better than they could have expected. The first year the profits amounted to £800, the second £1,200, the third £1,668, and the fourth (last year) to £2,298, making a total of £5,996.

South Shields.—The T.C. has decided to supply electricity free for the searchlight of the Life Brigade.

The sum of £590 has been transferred from the net profits of the electricity undertaking, which amount to about £1,350, to the reserve fund.

Spain.—A scheme is under consideration to use certain available water power at Sierra Nevada for the generation of electrical energy which is to be transmitted to Malaga, a distance of 140 kilometres. The plant will have a capacity of 4,000 H.P.

Stockton-on-Tees.—The annual report on the electricity undertaking shows that the loss is £714 13s. 5d., against £819 3s. 10d. in the previous year. The gross profit was £1,865 13s. 2d.

Sutton Coldfield.—A loss of £2,207 is reported on the two years' working of the electricity undertaking. For penalties under contract the Council had received £490, leaving £1,717 to be contributed from the rates.

Swindon.—The following scale of charges for electricity for power purposes has been fixed by the T.C.:—Under 5,000 units per annum, 2½d. per unit; between 5,000 and 10,000 units, 2⅜d.; between 10,000 and 15,000, 2¼d.; between 15,000 to 20,000, 2¼d.; between 20,000 and 25,000, 2d. All applications for over 25,000 units are to be considered on their merits, the Council reserving the right to charge the full 2½d. per unit for current taken between one hour after sunset and 8 p.m. in the winter months.

Thirsk and Sowerby.—Arrangements have been made with the Northern Counties Electricity Supply Co. to supply energy to these places for lighting purposes.

Torquay.—During the past year the expenditure on the electricity undertaking was £5,507 and the income £5,821, showing a profit of £314.

Warrington.—The report on the past year's working of the electricity undertaking shows a net loss of £495 8s. 3d. The recent reduction in price lowered the income by £439. The gross profit was £2,835.

Whitby.—At the meeting of the U.D.C. on May 6th, it was decided to instal in the electricity works two of Babcock and Wilcox's mechanical chain-grate stokers, and a fan for induced draught, at a cost of £650.

It was also decided to extend the cables to the Fishburn Park Ward, and to have all the public lamps on the cable route electrically lighted.

ELECTRIC TRACTION NOTES.

Bolton.—In order to obviate the expenditure of £18,000 on laying a tramway track to Darcy Lever, the T.C. has decided to experiment with a motor-bus service.

Brighton.—A largely-signed petition has been received from the Preston Park ratepayers in favour of better travelling facilities. After the tramways were started the 'buses were withdrawn, and now there is no means of communication between Brighton and Preston. The petitioners urged the importance of the Corporation at once starting a service of motor vehicles, pending the consideration of a tramway service. The committee decided to instruct the engineer to report, with plans and estimates of the cost, on a double line of tramway from the present lines to the borough boundary. Numerous complaints have been received about the delay in the construction of the London Road lines.

Crewe.—The T.C. on May 6th, by 15 votes to 11, approved of a draft prov. order promoted by a Manchester firm of electrical engineers for the construction of electric tramways in the town. The terms are that the promoters shall pay to the Corporation a wayleave of £100 per mile, and take energy from the Council.

Croydon.—The action of the Mayor of Croydon (Sir Frederick Edridge) in writing letters to Birmingham in defence of the British Electric Traction Co., copies of which were circulated in Birmingham by the company, has come in for considerable criticism, it being contended that the mayor should have kept himself outside the fight going on at Birmingham. In the first letter the mayor wrote:—"It is, of course, absurd to say that the British Electric Traction Co. have been turned out of Croydon; and, in my opinion at any rate, they are carrying out the terms of the lease in a generally satisfactory way." In the second letter the acting town clerk of Croydon wrote:—"The mayor requests me to state that our tramways are leased to the British Electric Traction Co., and the company have in all respects fulfilled the requirements of the lease, and have, in his opinion, most fairly catered for the general requirements of the public." The mayor, in reply to the criticisms which his action has elicited, said that a newspaper was shown him in which it was stated that the British Electric Traction Co. had been kicked out of Croydon, and the company asked him to state in writing whether it was so or not. In what he wrote he was excessively careful to make it clear that he was only expressing his own personal opinion as to whether they had carried out the lease in a proper way. With regard to the second letter, he was perfectly prepared to take the responsibility for it. He thought nothing was said in that letter but what was bound to be said to a friendly body writing to them for information.

Derby.—The T.C., after a long discussion, decided at last week's meeting to adopt the overhead trolley system, and voted £85,565 for carrying out the scheme on four routes upon which the roads will not be interfered with in connection with the great sewage scheme now in progress. Alderman F. Duesbury, the chairman of the Tramways Committee, in moving the adoption of the report, reminded the Council that they obtained power to construct electric tramways in the town two years ago, and the chief reason these powers had not been exercised before was because the special drainage scheme would interfere with the line in different parts of the town. The Committee, after considerable discussion, were unanimously in favour of overhead traction, which had been proved to be cheaper and more successful in every way than any other system of traction. For the four routes which they recommended should be started as soon as possible, they asked £85,565, and they had borrowing powers to the extent of over £286,000 for the entire scheme. He hoped the tramways would eventually assist the rates, and not require assistance out of them, and from figures he had worked out, he considered this was most probable. Mr. J. Dean seconded, and several members asked for the discussion to be adjourned so that they could have time to thoroughly consider the reports of the experts, whilst Mr. John Smith said the trade of the town did not warrant them embarking upon such a scheme, the sum they were facing that day being really £198,965, as, in addition to the £85,565 asked for, there was a debt on the present trams of £30,000, a contemplated expenditure of £50,000 by the Electric Light Committee, and £33,000 in connection with the tramways arrangement in Tull Street. Alderman Duesbury, in replying to the discussion, said the Council had had ample time to consider the question, and were committed to the scheme. As to the complaint that

they gave too much for the existing tramways, he contended that they gave a fair price; they could have sold them for double the price the following day. In the end the report and resolutions were agreed to *nem dis.*

Dover.—The T.C. has received sanction for a loan of £24,000 for electric tramway purposes.

Dudley.—At the meeting of the T.C. last week, Alderman G. H. Dunn stated that during the past year the receipts of the Dudley and Stourbridge tramways amounted to £41,820, and that after payment of expenses and the placing of £2,000 to depreciation account, there remained a net profit of £11,365. He had, he said, not the slightest doubt that half the profit came out of the borough of Dudley; and the time was now ripe for the purchase by the Council of the lines within the borough in accordance with the agreement with the B.E.T. Co. The Council, the Alderman added, would have to make an offer, and if an agreement could not be otherwise come to, the matter would have to be settled by arbitration.

Halifax.—The Tramways Committee has been inquiring into the Schiemann (? Siemens) system of electrical motor omnibuses, which take their current from overhead conductors, and has decided to order a trial car. The cost of installation is estimated at only a seventh that of electric tramways.

Ilkeston.—After many months' delay, there is now a reasonable prospect of an early running of the electric tramcars at Ilkeston (Derbyshire). At the outset the scheme for which the Corporation obtained Parliamentary sanction, included not only the laying of tramways, but the generating of electrical energy. Shortly afterwards the Notts and Derbyshire Power Co. obtained Parliamentary authority to supply electricity in the district, and after negotiation the Corporation arranged to take power in bulk from the company on terms which were deemed more advantageous than by producing it themselves. The company entered into an agreement to supply the Corporation in August of last year. A large station has been built at Ilkeston, near the Manners Colliery, but has only just been sufficiently completed to enable the company to produce the energy required. The tramlines were laid several months ago. The long delay has been much commented on in the town, and the payment of interest on the loans has led to an increase of the rates as the tramways have been lying idle for about nine months longer than was expected. During the past few days trial runs have been made, and the Corporation has invited the Board of Trade to make its official inspection.

Lincoln.—The T.C. and the Bracebridge U.D.C. have decided to offer £8,000 for the Lincoln tramways, which belong to a company whose paid-up capital is over £10,000.

London.—Hammersmith.—The plans and sections submitted by the engineer of the London United Tramways, Ltd. showing the proposed street widenings and the method of constructing the proposed lines in Dalling Road, Paddenswick Road, and Askew Road, were before the Borough Council last week, and were passed.

Manchester and North Cheshire.—An arrangement has been come to between representatives of the Manchester Corporation on the one hand and the promoters of certain tramway schemes in North Cheshire on the other, whereby the Corporation will secure control of the important series of lines which are to connect the city with the populous residential districts of Sale, Altrincham, Gatley and Cheadle, with connection north of the River Mersey, in Lancashire, with the Eccles and Salford systems. The lines to be constructed are those promoted by the Manchester Southern Tramways Syndicate in a Bill now before Parliament. They will furnish through routes between Stockport and Eccles and Stockport and Bowdon *viâ* Cheadle and Northenden, without crossing Manchester, and will open up a considerable tract of country at present but sparsely occupied. Another effect of the arrangement will be to place the Manchester and Altrincham traffic, *viâ* Stretford and Sale, entirely in the hands of the Manchester Corporation. It is considered probable that the Cheshire Lines Committee will withdraw its opposition to the Manchester Southern Tramways Bill, in which case the Bill will pass through its remaining stages as an unopposed measure.

Manchester.—The agreement between Manchester and Salford as to the running of through cars on the tramways has been signed, and it is expected that the new arrangements will come into operation in less than a month.

Nelson.—The T.C. and the Barrowford U.D.C. have arrived at an agreement with regard to the construction of electric tramways to the latter place, and the B. of T. is to be asked to amend the order whereby the Nelson Corporation will be authorised to construct the tramways authorised by the Barrowford order.

Newport (Mon.).—Mr. Horace F. Parshall, consulting electrical engineer, in reporting the progress made with the contracts in connection with the power station of the Corporation, recommends that automatic stokers be now purchased to complete the third unit of plant.

The B. of T. has forwarded to the Corporation a copy of the report of Mr. A. P. Trotter, its electrical expert, upon the portion of the tramway system recently inspected by him. The Board inquires whether the Corporation is prepared to comply with the requirements contained in the report, and to this the Corporation has assented.

Northampton.—The T.C. has decided to apply to the B. of T. for a loan of £85,000, for the conversion of the horse tramways to electric traction. For the permanent way £35,732 is allowed; for the generating station, £4,100; for power plant, £13,600; for car-sheds, workshops, offices, &c., £6,500; for lighting the car-shed and station, £500; for underground cables and feeders, £4,000; for overhead line, £60,000; for 20 cars, £10,000; for contingencies, £4,568.

Nottingham.—During the 12 months ended March 31st, the Corporation electric tramways carried 24,534,630 passengers, and the total receipts amounted to £115,149. The undertaking represents a capital expenditure of over half a million sterling.

The work in connection with the Market Street extension of the tramways is in full swing, the operations being carried on day and night without intermission. It is hoped to have the section completed in a fortnight's time.

Oldham.—The loss on the working of the electric tramway service for the past municipal year has not yet been made public, but is known to be several thousands of pounds. To effect economies in the working and, if possible, to increase the receipts, which, for the week ending May 3rd, were £1,212, the Tramways Committee has just approved of a scheme involving sweeping changes in the running of the cars. The number of cars required to work the service is 42, as against 56 in use at present. The reduction in the number of men employed is about 30, wages £40, and cost of energy £80 per week. Taking an average week in April, the details of running are:—Number of cars, 56; car-miles run, 32,617; receipts, £1,170 17s., or 8·61d. per car-mile. The car mileage under the proposed scheme is 23,003 (estimated). Some light was thrown upon the view taken by the Electricity Committee of the Oldham Corporation on this reduction in the number of cars used, by a discussion at the last meeting of the Tramway Committee. Complaint was made of the price charged for electric energy, whereupon Alderman Harrop, chairman of the Electricity Committee, protested against these slurs on his department. He urged the Committee not to lose sight of the great preparations which the Electricity Committee had made to cope with the anticipated demands of the tramways. Now, instead of 150 cars, they only proposed to run 42. The Electricity Committee had a much greater plant than was required, owing to the blunder of the Tramways Committee.

The T.C. has decided to ask the B. of T. for power to borrow £100,000 to cover extra expenditure incurred in the construction of the tramways. The working of the lines, up to the present time, seems to have resulted in a rather serious deficit. The chairman of the Tramways Committee stated, at the meeting of the Council last week, in reply to a question, that he was not prepared to say what the loss had been. Councillor Bolton asked if it would amount to as much as £10,000. The chairman replied that "very probably it would."

Railways in 1902.—The Board of Trade return relating to the working of railways in the United Kingdom for 1902 shows that the total paid-up capital was £1,216,804,000, against £1,195,564,478 in 1901. The gross receipts were £109,534,000, against £106,615,753, and the working expenses £67,907,000, against £67,546,677; the net receipts were £41,627,000, against £39,069,976.

Swansea.—A correspondent says that the Corporation has adopted the overhead system for the electric tramways. Has Swansea profited from the experience of Wolverhampton? If so, our work has not been in vain.

Walsall.—The T.C. has decided that the whole of the permanent way of the tramways from the Bridge to Mellish Road, which is worn out, shall be reconstructed at an estimated cost of £4,000, and also that, in order to provide for the proper and expeditious working of the increased traffic, consequent upon the extension of the tramways, the line from the Bridge to W'ton Street be reconstructed, a double line being laid down in Park Street, and two sets of double lines and crossings, with a refuge for foot passengers on the Bridge, at an estimated cost of £3,000.

Warrington.—The electric cars have been running for nearly 12 months, and the number of accidents has been so small that the insurance company has renewed the policy for a less sum than last year. The electricity department showed a loss of £495 on the year's working. Alderman Monks expressed the conviction that next year the accounts would show a profit. The revenue from the tramways had been £7,913, and the working expenses were £5,100. There was a net profit of £652.

Wolverhampton.—For over four hours the T.C. on Monday again discussed in committee the report of Mr. Shawfield, the borough electrical engineer, on the 12 months' working of the Lorain system of traction, and the question was again adjourned for further consideration. During these four hours only seven speeches were delivered, three in favour of taking over the 11 miles of track, and four against. It must be confessed that the arguments adduced do not seem to advance the question, whilst the confusion of figures presented first as authoritative, and subsequently controverted or withdrawn, only tends to mystify. The public is taking a warm interest in the controversy, as shown by the large attendance of ladies and gentlemen at the Council meetings. The *Express and Star* on Saturday published in its columns the recent article from the Electrical Review on Wolverhampton's municipal experiment, and it has received considerable attention. The most recent suggestion of the advocates of the Lorain system is to take over the track that is now laid down, to take up the Lorain boxes on the Bilston Road and put them down the Penn Road; to put the Lorain boxes also down the Waterloo Road to Bushbury; and to electrically equip Willenhall Road, Bilston Road, Dudley Road, and Wednesfield Road with the overhead system. By this means there would be secured inter-communication on the three routes of

the borough where the lines converge on those of the British Electric Traction Co., and the æsthetic beauty of the town would be preserved on the three routes which lead to the "green borderland" of the Black Country.

TELEGRAPH AND TELEPHONE NOTES.

The International Telegraph Conference.—The Bureau International des Administrations Télégraphiques announce in their Notification, No. 554, of the 1st inst., that the Eastern Extension, Australasia and China Telegraph Co., have become official adherents to the International Telegraph Convention of St. Petersburg, of July 22nd, 1875. The *St. James's Gazette*, of May 7th, says there are indications that the United States of America are considering their position with regard to becoming official adherents, and it seems probable that sooner or later the Atlantic Cable Companies and others, as well as those countries which have not yet joined, will reconsider their position and become members. Countries granting concessions and privileges to cable companies now generally seem to incline towards making agreements with adherents to the Convention. When all are members it would then seem possible to make the Convention more in the nature of an agreement having for its object the full observance of its provisions. The delegates to the Telegraph Conference will meet on May 20th next in the Examination Hall of the College of Physicians and Surgeons, on the Embankment, and the first entertainment will be a dinner given by the Postmaster-General on the same evening at 7.15 p.m. for 7.30 p.m., at the Grafton Galleries, Grafton Street, W. The delegates, we are informed, will stay at De Keyser's Hotel, on the Embankment.

Reuter's agent at Valparaiso says that firms of all nationalities in Valparaiso are sending a petition to the Berne International Telegraph Conference, begging reconsideration of the proposal to render an official vocabulary compulsory.

German Atlantic Cables.—The *Standard* says that the laying of the second German Atlantic cable was begun at Borkum on Sunday. Herr Moll, Director of the German Atlantic Cable Co., presided at the ceremony. The shore end of the cable having been laid in the beach, the new cable steamer, *Podbielski*, started to lay the cable through the North Sea and English Channel. In his address on the occasion, Herr Moll laid stress on the fact that this was the first large submarine cable made by a German cable factory, namely, the North German Marine Cable Works, at Nordenheim. It is hoped that the laying of the cable will be completed next year, and that the whole length will be open, at the latest, by January 1st, 1905.

Lecture on Telephony.—On Friday next (May 22nd) Mr. F. C. Raphael is to deliver a lecture on telephony, under the auspices of the Westminster Lecture Society. The lecture will deal mainly with the working of a telephone exchange and the arrangement of a telephone system generally, with particular reference to that in London. The lecture, which will be delivered at the Caxton Hall, Westminster, at 3.30 p.m., will be illustrated with lantern slides and diagrams, and probably also a working model of a telephone switchboard will be shown. Tickets (5s. each) may be obtained from the Lecture Agency (Ltd.), Outer Temple, E.C.

The Telegraph Wire Export Trade.—We have frequently commented upon the fluctuating character of the export trade of this country in telegraph wire and apparatus connected therewith. This tendency is well illustrated by the returns now available for April, which show that during the month the value of the shipments reached a total of no less than £920,708, as compared with only £230,280 in March last, and £54,541 in April, 1902. For the four months ending with April, the exports have reached a total of £1,261,741, which contrasts with only £803,896 in the first four months of last year.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Trinidad-Demerara No. 1	Aug. 27, 1901 ..	..
Dominica-Martinique	May 8, 1902 ..	..
St. Lucia-Martinique	May 8, 1902 ..	..
Guadeloupe-Martinique	May 9, 1902 ..	..
Martinique-Puerto Plata	July 10, 1902 ..	..
Cayenne-Pinheiro	Aug. 13, 1902 ..	..
St. Vincent-Grenada	May 8, 1903 ..	..
St. Lucia-St. Vincent	Sept. 19, 1902 ..	..
Beissa-Issa	Oct. 22, 1902 ..	..
Beissa-Yemani	Oct. 22, 1902 ..	..
Paramaribo-Cayenne	Feb. 27, 1903 ..	..
New York-Haiti	April 13, 1903 ..	..

Wireless Telegraphy.—Reuter says that on May 9th the Minister of Marine and Signor Marconi were present at some successful experiments in the transmission of messages with the Hughes apparatus at the Monte Mario wireless telegraph station, with a view to the use of this apparatus in connection with wireless telegraphy in the Navy. News has also arrived from the same source stating that some perfectly successful experiments have been conducted at Spezia, in the transmission of multiple radiograms by the Marconi system from one station to several others. The radiographic station of San Vito at Spezia transmitted a considerable number of despatches to Palmaria and Leghorn. "All the despatches arrived clear and complete at the respective stations without the least confusion arising. These results are regarded as solving the problem of syntonisation."

A dispatch from Ottawa in the *Times* reports Mr. W. S. Fielding, Dominion Minister of Finance, as stating in the House of Commons that the Marconi wireless telegraph system had not been the success hoped for, and the Government did not propose to make further contributions towards it. Mr. Vyvyan, the chief engineer of the system at Table Head, says there has been no hitch except a temporary breakdown of a mechanical nature.

Reuter's agent at Rome quotes from the *Tribuna* that the British Government has invited Signor Marconi, "as well as the representatives of the various submarine cable companies, to take part in an international conference which will meet in London on May 26th, to consider the revision of the regulations governing international telegraphy."

CONTRACTS OPEN AND CLOSED.

OPEN.

Battersea. — June 2nd. Prepayment meters. See "Official Notices" to-day.

Belgium.—May 29th. Tenders are being invited until May 29th by the municipal authorities of Charleroi for the electric lighting of the town. Tenders are to be sent to l'Hotel de Ville, Charleroi, whence particulars may be obtained.

Belgium.—Tenders are at present being invited by the Belgian State Railway Authorities at La Bourse, Brussels, for the the supply of 34 continuous-current motors, ranging in power from 1 to 25-H.P., one 165-KW. shunt-wound continuous-current dynamo, one ditto of 200-KW. capacity, two compensating 1·75-KW. dynamos, and two ditto of 20-KW. capacity.

Brighton.—June 8th. The Council wants tenders for 5,400 KW. generating plant at Southwick power station, and 5,000 KW. motor-generator converting plant, together with switchboards, instruments, &c., at North Road power station. See "Official Notices" April 17th.

Burma.—June 26th. The Burma Railways Co., Ltd., wants tenders for an electric light and power plant for the Insein workshops. Particulars, specifications, &c., from C. E. Cardew, locomotive and carriage superintendent.

Edinburgh.—June 1st. The Council wants tenders for electric wiring at the North-West extension, City Chambers. See "Official Notices" to-day.

Felixstowe.—May 16th. Cables, arc lamps and poles, for the U.D.C. See "Official Notices" May 1st.

Foot's Cray.—The Council is inviting offers from parties willing to work the prov. order under lease. See "Official Notices" May 8th.

Germany.—The Municipal Authorities of Neustadt-am-Sauer are at present inviting tenders for the construction of an electric tramway in the town.

Gloucester.—June 16th. Generating plant (two 200-KW. sets), condensing plant, pipework, switchboard, battery and boosters for the city light railways. See "Official Notices" to-day.

Govan.—May 18th. Steam dynamos, boilers, superheaters, stokers, economiser, cooling tower and condensing plant, piping and electric crane. See "Official Notices" May 1st.

Hungary.—May 31st. Tenders are invited by the municipal authorities of Veszprem for the lighting of the town either by gas or electricity.

Hungary.—August 31st. Tenders are being invited until August 31st next by the municipal authorities of Besztercebanya (Neusohl) for the establishment in the town of a central electricity generating station of a capacity of 500 H.P.

Islington.—May 27th. Alternating current transformers. See "Official Notices" April 24th.

Johannesburg.—June 8th. Rails, points and crossings, tie-bars, &c., for the electric tramways. See "Official Notices" May 1st.

Radcliffe.—May 30th. Steam piping, balancer and motor-generator, and battery. See "Official Notices" to-day.

Rangoon.—July 1st. The Municipal Committee wants tenders for carrying out its electric lighting license, and particulars, forms, &c., can be obtained from the officiating secretary (W. Shircore), Rangoon municipality, at Rs. 75 per set.

Rotherham.—May 18th. Electricity meters. See "Official Notices" to-day.

Worksop.—May 27th. One Lancashire boiler and one 150-KW. steam generator. See "Official Notices" to-day.

Rotherham.—May 18th. The Tramways Committee invites tenders from parties willing to take over advertising privileges on the electric cars. See "Official Notices" to-day.

Spain.—May 25th. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until the 25th inst. for the supply of 60 tons of iron telegraph wire 4 mm. diameter. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, 10, Carretas, Madrid.

Stockport.—May 18th. Overhead equipment for tramways extensions. See "Official Notices" May 8th.

CLOSED.

Batley.—The T.C. has accepted the tender of the British Electric Car Co. for the supply of tramcars.

Battersea.—The E.L. Committee has accepted the tender of the Walsall Electrical Co., Ltd., for extensions to the switchboard at the central station, for £136.

Birmingham.—Messrs. Royce, Ltd., Manchester, have secured an order for two electrically-driven overhead travelling cranes, required for the new foundry at the Lion Works of Messrs. Kynoch, Ltd. The cranes are to be of 30 and 10 tons capacity respectively, and of the three-motor type, the span being 62 ft. in each instance.

Bradford.—The Corporation Electricity Committee has accepted the tender of Messrs. Babcock & Wilcox for four boilers for the Valley Road generating station, at £6,000.

Brighton.—The T.C. has accepted the tender of Messrs. C. G. Reed & Son, Ltd, electrical engineers, of Brighton, for the installation of the electric light, telephones, and fire alarms in the Borough Sanatorium, at £217.

Burnley.—The T.C. has accepted the tender of Ferranti, Ltd, for new panels, &c., for the traction switchboard at the power station.

Chepstow (Mon.).—The Hart Accumulator Co. has secured the order for the storage battery required for the electric lighting here.

Colchester.—The T.C. has accepted the tender of Messrs. Davey, Paxman & Co. for condensing plant at the electricity works at £690. The Electric Light and Power Committee had previously accepted the tender of Bertrams, Ltd., at £603, but the desire to support local industry resulted in the committee's decision being altered.

Croydon.—The Corporation has accepted the tender of Callender's Cable & Construction Co., Ltd., for the supply of cable for the electricity works for the ensuing year, and Mr. Charles Jackson has been entrusted with the contract for the erection of a new condenser house at the generating station, at £798.

Darlington.—The British Electric Equipment Co. has secured the contract for the overhead equipment of the Darlington Light Railways. The company's contracts for Brighton and Ipswich overhead equipments are now well under way.

Dundee.—Messrs. Siemens Bros. & Co. are to supply a new switchboard for the electricity works; the contract for boosters has been placed with Messrs. Mather & Platt; meters have been ordered from the Reason Manufacturing Co. and Messrs. Chamberlain & Hookham; and a six months' contract for coal at 7s. 3d. per ton has been given to Messrs. Ireland Bruce & Co, of Dundee.

Great Marlow.—Messrs. Wethered & Sons have placed with Messrs. Crompton & Co., Ltd., the contract for the complete lighting of their brewery, including a Galloway boiler, two dynamos coupled to engines by Ransome, Sims & Jefferies, battery, &c.

Glasgow.—In connection with the main drainage scheme, Dalmuir section, the following are amongst the subcontractors with Messrs. D. Stewart & Co., as chief contractors:—Motor for economiser, electric generating plant, and motors, Mavor and Coulson; engines, Belliss & Morcom, Ltd.

Grimsby.—The Corporation has placed the order for centrifugal pumps with direct coupled motors for the old cemetery pumping station, with the Northern Electrical Co., of Grimsby.

Isle of Man.—Messrs. Robert W. Blackwell & Co., Ltd., have the contract for feeder lines required by the Manx Tramways, for their reconstruction on the three-phase high-tension system. The contract includes the supply of the bare copper feeders, and a full line of special high and low tension insulators, switches, lightning arresters, &c.

Nelson.—Messrs. R. W. Blackwell & Co., Ltd., have received the T.C.'s order for the first extension of the tramway system. The contract includes the track and overhead line, and the whole must be ready for traffic within three weeks from the date of commencing work. The existing track and line were completed by Messrs. Blackwell in February last.

Newport (Mon.).—The Corporation has given an order for motors and switch-gear, to Messrs. Johnson & Phillips at £649.

Nelson.—On May 6th the T.C. accepted the following tenders for the electric tramway scheme:—Messrs. R. W. Blackwell and Co., for rails and overhead equipment; Messrs. A. & F. Manuelle, London, for granite setts.

Salford.—The T.C. on May 6th accepted the following tenders for supplies to the Tramways and Electricity Works:—Messrs. Walter Scott, Ltd., Leeds, for 1,500 tons of tram rails, with fish and sole plates; Messrs. Guest, Keen & Nettlefolds, Ltd., Birmingham, for fish plate bolts, sole plate bolts, and tie bars; General Electric Co., for cable accessories; Messrs. Glover & Co., for copper strip; Messrs. Siemens Bros., for solder and mica sheets; Callender's Cable Co., for bitumen compound for joints; Howard Conduit Co., Ltd., for Trininad bitumen and asphalte troughing; Keighley Engineering Co., Ltd., for S.P. house fuse boxes; Reason Manufacturing Co., for concentric house fuse boxes; Messrs. Hartcliffe, Lee & Malkin, for brass and gun-metal castings; Messrs. Stewart & Lloyd, Ltd., for wrought-iron pipes and fittings; Stanton Iron Co., for cast-iron pipes and bends; Albion Clay Co., three-way troughing; Albion Clay Co. and Doulton & Co., for three-way conduits; Messrs. Crompton & Co., for carbons for arc lamps; General Electric Co., Ltd., for electric fittings; Brush Electrical Co., incandescent lamps; Messrs. Sperryn & Co., Ltd., for switches; General Electric Co, Ltd., for insulated screwed tubing; Veritys, Ltd., for motor starters; British Thomson-Houston Co., Ltd.; Lancashire Dynamo and Motor Co, Ltd., and Messrs. Mather & Platt, Ltd., for motors to be let out on hire.

Stalybridge. — The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board, on May 7th, accepted the tender of Messrs. E. F. Blakeley & Co., of Liverpool, for iron and steel work for the main car-shed.

Stepney.—The E.L. Committee received the following tenders for cables and conduits, for ten thoroughfares:—

W. T. Henley's Telegraph Works Co., Ltd. .. (Accepted)	£3,923
Callender's Cable and Construction Co., Ltd.	4,135
Siemens Bros. & Co., Ltd.	4,341
W. T. Glover & Co., Ltd.	4,376
British Insulated and Helsby Cables, Ltd.	4,410
St. Helens Cable Co., Ltd.	5 671

Whitby.—The U.D.C. has decided to instal two mechanical stokers with an induced draught fan. The following tenders were submitted:—

Babcock & Wilcox, Ltd., two mechanical stokers	£326
,, ,, Induced draught fan	195
Underfeed Stoker Co., two stokers with forced draught	360
,, ,, two stokers with induced draught	574
,, ,, induced draught fan	286
Meldrums, two mechanical stokers with steam forced draught ..	328
Musgrave & Co., Ltd., induced draught fan	151
Davidson, induced draught fan	325
Matthew & Yates, induced draught fan	185
Bennis & Co., two mechanical stokers	302

Wimbledon.—The tenders of the following firms have been provisionally accepted in connection with the extensions to the Wimbledon Electricity Works:—625-kw. steam alternator, the British Thomson-Houston Co. (with Browett-Lindley three-crank engine); boiler, feed pump, economiser and pipework, Babcock and Wilcox, Ltd.; chimney, the Alphons Custodis Chimney Construction Co.

FORTHCOMING EVENTS.

Saturday, May 16th.—At 10 a.m. I.E.E. (Students). Visit to the works of Messrs. Elliott Bros.

Monday, May 18th.—At 8 p.m. Society of Arts. "Mechanical Road Vehicles," by W. Worby Beaumont. (Cantor Lecture IV.)

Tuesday, May 19th.—At 8 p.m. I.E.E (Glasgow). Annual General meeting. "Three-Phase High-Voltage Electric Railways, with special reference to the Valtellina Railway," by M. T. Pickstone; adjourned discussion and lantern views of the line. "Commutator Design," by W. B. Herd.

Wednesday, May 20th.—At 7.30 p.m. I.E.E. (Students). Annual general meeting for the election of the Committee for Session 1903-4; followed by a discussion, to be opened by Mr. J. R. Hewett, on "The Relative Merits of Various Types of Prime Movers for the Generation of Electrical Power."

Friday, May 22nd.—At 5 p.m.—Physical Society. Exhibition of Nernst Lamps, by J. Stöttner. (See "Notes" pages to-day.)

INSTITUTION OF ELECTRICAL ENGINEERS.

DIVIDED MULTIPLE SWITCHBOARDS: AN EFFICIENT TELEPHONE SYSTEM FOR THE WORLD'S CAPITALS.

By W. Aitken, Member.

(Abstract of paper read on April 30th, 1903.)

The designing of an efficient telephone system for one of the great centres of industry requires much careful consideration, as the subject bristles with difficulties. The problem, however, is a most interesting one. Any system proposed must be as simple as possible, consistent with efficiency—quick, direct, and reliable.

Before putting my suggestions before you, it will be advisable to consider briefly the methods that have already been put forward. The general practice has been to divide the area to be telephoned into sections, to place in each section an exchange, to connect the various exchanges together by direct junction wires where the traffic is considerable, and to connect the various exchanges or groups of exchanges also to one or more junction centrals, through which connections are obtained to small exchanges where the traffic is not sufficient to warrant direct junctions being run, so that complete intercommunication may be established. Fig. 1 shows such an arrangement.

The weak spot of such a system is the multiplicity of junction calls. Only a small proportion of the total calls can be dealt with direct by one operator. In the larger exchanges 50 per cent. of the calls may be local, but in the majority of cases the percentage will be much smaller, in some cases only 5 or 10 per cent; 50 to 95 per cent. of the calls have, therefore, to be handled by two—in some cases three—operators. The service is not, therefore, ideal. The call has to be passed from exchange to exchange, and a junction call takes about twice as long to complete as a local one. The subscriber's number has to be received by more than one operator. There is also the possibility of delay and inefficient transmission, because of the complications of the junction circuits and their consequent liability to get out of order. In practice it is found that for an efficient service where there are a considerable number of exchanges, for every 100 subscribers' lines 20 junction lines are required, 10 per cent. for incoming work and 10 per cent. for outgoing work. In addition, the junction circuit is much more complicated than a subscriber's circuit; its apparatus is more intricate and requires more expert handling.

What is recognised as the best method of working junction lines, and used by the National Telephone Co., is as follows:—At the out-going ends, the lines are multipled three times on every two sections, so that every operator has every line almost directly in front of her. At the incoming end, the junctions are arranged in groups of 25 (average number) per operator and end in plugs, only signalling apparatus being in addition. A service or order wire is provided per 25 junctions. This at the outgoing end is multipled on every operator's keyboard, and is connected to her telephone by pressing a small push-button. At the incoming end this service wire is connected direct to the operator's receiver. When a subscriber calls, the first-mentioned operator connects with the service wire and informs the listening operator at the other exchange the number wanted, this operator allots the junction to be used as she knows by the position of the plugs what lines are available, tests the line wanted, and, if free, inserts the junction plug, the originating operator at the same time connecting the subscriber to the junction specified. The subscriber may be rung by either the originating or the incoming operator, but, preferably, by the latter and automatically. When the clearing signals are received from the subscribers by the originating operator, she withdraws the plugs and automatically signals to the incoming end, the operator there then withdrawing the plug also.

We will just glance for a moment at the circuit of an up-to-date exchange—on the common battery system—so that you may appreciate the slight additional complications which are made necessary by the divided system to be described. Figures are given showing the line circuit of the Western Electric Co.'s system, and the line and cut-off relays, in detail.

In such a system all lines are multipled on every section of the switchboard, each containing about 300 subscribers' lines served by three operators. The multiple and answering jacks are branched from opposite sides of the intermediate distributing board. A line and cut-off relay is in combination with each line. The subscriber's instrument has a condenser in circuit with the bell normally, which prevents the central battery discharging. When a call is made by taking the telephone from its rest, a path is provided for the current through the microphone and induction coil, and the line relay is energised. The calling lamp in the local circuit glows, and the operator answers by inserting a plug into the jack hole immediately above the lamp. The cut-off relay is then energised and cuts the line relay out of circuit so that the calling lamp ceases to glow. The connection is completed by the insertion of the other plug of the same cord into the multiple jack of the line wanted.

Diagrams are given of the line and cord circuit of the Kellogg switchboard and supply company. The peculiarity of this line circuit is that there are only two wires throughout the switchboard per line instead of three as is usual, and that the lines are not connected to the multiple until the plug is inserted. The cut-off relay coil is tapped off the line circuit instead of being on the third wire.

Having now considered the general principles of the usual methods of working, let us consider a concrete case, dealing with an area served by two large exchanges. Such a condition could hardly exist in practice. There would almost certainly be lines to smaller and more distant exchanges. In large systems it is usual to reckon the number of junctions necessary at 20 per cent. of the number of subscribers' lines in an exchange.

In considering the following hypothetical case, I have calculated on 15% being necessary for working between two large exchanges.

Between two exchanges of 10,000 lines each 15 per cent. of junction lines would be required, 7½ for incoming work to one exchange and 7½ to the other, or 1,500 metallic circuit lines. To accommodate the incoming junctions 20 switchboards (10 in each exchange) would be necessary with 25 lines per operator and three operators' positions per board. Sixty operators and six supervisors are therefore required to work the incoming junction lines in the two exchanges, and as each subscriber's operator has a large proportion of connections for the other exchange she cannot attend to so many calls as she could do if all the work were local. On each junction switchboard the complete multiple of 10,000 subscribers' lines must be repeated, and on every subscriber's section 1,125 spring jacks must be multiplied for outgoing work to the other exchange, these being multipled three time on two sections to place them well within the reach of the operators.

Fig. 1.

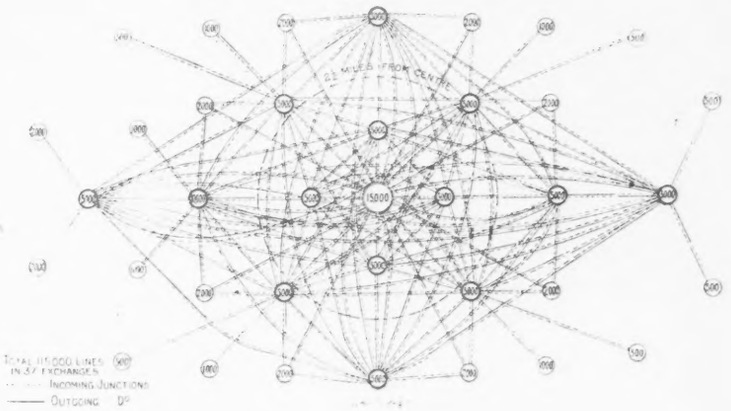
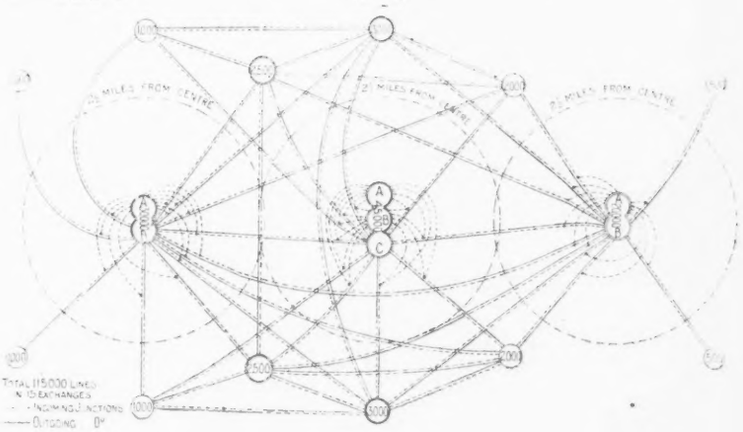


Fig. 2.



The provision of junctions between exchanges is a difficult one, for to provide an ideal service the number of circuits must be sufficient to carry the maximum number of calls at the busiest half hour of the busiest day, and necessarily many of these junction circuits would be lying idle the greater part of the time.

In the earlier days of telephony there was not much need for the divided board, as the great cities were efficiently telephoned with switchboards having a capacity of from 6,000 to 15,000 lines. When necessary a number of these were fitted and connected by junction lines. Even to-day the system I advocate is worthy of consideration practically only in the world's capitals, where it may be expected that the number of telephone subscribers may reach something like 100,000.

Underground work is essential with the divided board, owing to earths, &c., giving false calls, and it is only of late years that facilities could be obtained for work of such a nature, and even to-day wayleave facilities are not always obtainable.

It is only in recent years also that satisfactory conduits for large capacities have been introduced, and that hermetically sealed lead-covered air-space paper cables containing a large number of conductors manufactured. The system I am about to describe to you is just beyond the experimental stage, and I think the time is now ripe for it to receive careful attention.

Such a system must, of necessity, be an underground metallic circuit system. The average length of subscribers' lines would be greater with a divided system than with the junction system, as a larger area would be served from a central, but against this must be placed the great reduction in the number of long junction circuits with their elaborate switchboard equipment.

In my opinion, it is only by adopting a divided multiple switchboard system of working, in which the exchange is divided into several sections, the subscriber having the power to call any one of the sections at will, that the large cities of the world may be more efficiently telephoned.

By a divided multiple exchange, I mean an exchange divided into two or more groups, each group having a multiple of a proportion only of the total subscribers' lines, each subscriber having the power of calling each of the groups at will and obtaining connection with the subscribers multipled thereon without the intervention of a second operator. The advocates of the divided multiple board system believe in centralisation and the abolition of junction lines as far as possible. The multiple of each switchboard or division is made as large as can be conveniently reached by the operator, and where those who favour the divided system differ from the advocates of the junction system is in that they ask the co-operation of the subscriber by giving him the selecting of the group of switchboards on which the line wanted is connected. Two or three push-buttons or switches are fitted in combination with the ordinary subscriber's instrument, one, say, labelled 1 to 10,000, the second 10,001 to 20,000, and the third 20,001 to 30,000, or in other suitable divisions. In addition to taking the telephone from the switch-hook, the subscriber has to press the button of the group in which is the number required; he then gets the connection direct instead of as in the junction system, the first operator having to ask the second to assist her in completing the connection in a large proportion of the calls.

The central exchange on a divided system consists really of two or more great multiple switchboards serving a large area, and its total capacity may be from 30,000 to 60,000 lines, according to the size of the units and number of divisions. Instead, however, of having junction lines between the exchanges, the subscriber's line is branched to each division, and has a calling signal and answering jack on each, so that it can be connected to each of the multiples of the several divisions, his own line being multipled on one of the divisions, so that other lines may be connected to it. The subscriber can, therefore, greatly expedite the rate of operating for a great proportion of his calls, and at the same time he enables the operator to perform more work as a second operator more rarely intervenes.

A proportion of junction working will still exist to the exchanges more distant from the centre, but in most instances it will be possible to so design a system that 75 per cent. of the possible junction working will be eliminated. I have, therefore, based my estimates on this figure.

Fig. 1 shows a large populous area telephoned on the junction system, the total number of subscribers being 115,000 in 37 exchanges. The largest exchange has a capacity for 15,000 lines, or 13 per cent. of the total. In the two largest exchanges there is 22 per cent. and in three 26 per cent. Even if the three exchanges were each of 15,000 lines they would only contain 39 per cent. of the whole.

Fig. 2 shows the same area telephoned on the divided multiple system for the same number of lines in 15 exchanges. The largest exchange has 45,000 lines and the next 30,000 lines. In the former there is 39 per cent., in the two 65 per cent., and in three 83 per cent. of the total.

The lines on the diagrams indicate direction only and not the number of circuits necessary.

I may be accused, with a good deal of justice, of comparing a theoretically well divided system (fig. 2) with an imperfect junction system (fig. 1), but with the latter system local conditions and limitations, such as rivers, public parks, low-class residential neighbourhoods, &c., form natural boundaries beyond which for the sake of economical working it is not desirable to extend, and therefore single exchanges of the maximum size are not always possible or essential, whereas this does not apply to the same extent to the former.

Mr. M. G. Kellogg, of Chicago, was, I believe, the first to design and advocate a divided multiple board system, and a number of exchanges are now working in America on this plan. Usually two divisions have been adopted, but in one or more cases a four division board has been installed. In these pioneer exchanges the system was complicated by polarised relays and indicators on the switchboards, and at the subscribers' offices by commutated magneto generators.

In at least one case the magneto generators were replaced by the primary speaking battery, acting through an induction coil, giving a "kick" when the circuit was made and broken, sufficient to energise the calling signal. Suitable switches connected the current generating apparatus to line in the proper direction to actuate the signalling apparatus in the division required.

(To be continued.)

NOTES.

Birmingham Tramways.—On Tuesday the City Council had a long discussion with reference to the Tramways Committee's negotiations with Mr. Garcke and other promoters. The end of it all was the rejection of Mr. Garcke's amended offer, and the passage of a resolution to municipalise the system.

The Electric Railways Bill.—This Bill, upon whose provisions we have already commented at length in the Electrical Review, passed second reading in the House of Commons on Tuesday.

Trials of Electrical Motor-Cars.—The Advisory Committee on Electrical Vehicles of the Automobile Club of Great Britain and Ireland has decided to organise, subject to the approval of the Executive Committee of the Club, a series of trials of electrical carriages in May, 1904. It is proposed that the trials shall be limited to one class of vehicle which shall be run over a town route, with an optional long-distance run to test the capacity of the car on a single battery charge. In connection with the trials there are to be hill-climbing tests, in which speed will be a main factor. The trials will extend over six days, with the optional long-distance run on the seventh day. Marks will be deducted for all stops other than compulsory ones, and marks will be deducted for every mile of the course which may remain unfinished at the end of the day. In order to meet the views of those who wish to have trials extending over a long distance, a Sub-Committee, consisting of Messrs. T. Chambers, H. F. Joel, H. P. Northey and C. Oppermann, has been appointed to consider the question of arranging for quarterly trials of electrical vehicles, the distance to be from 50 to 100 miles.

The Glasgow Section of the I.E.E.—The annual report of the committee, which was presented at a general meeting of the section on Tuesday, shows that there has been 26 additions to the membership, and after allowing for losses by transference and removal, the net increase is 14 for the year; the total in all classes is now 203. The average attendance at meetings has been 62. The office-bearers of the section for the 1903-1904 Session are as follows:—

Past Chairmen.—Lord Kelvin, G.C.V.O., &c., &c.; Prof. Magnus Maclean, D.Sc.; Henry A. Mavor.
Chairman.—W. A. Chamen.
Vice-Chairman.—J. M. M. Munro.
Hon. Secretary and Treasurer.—E. George Tidd.
Ordinary Members of Committee.—A. R. Bennett; William M'Whirter; Prof. A. Gray, LL.D.; M. T. Pickstone; Prof. Francis Bailey; R. Robertson; Wm. Walker Lackie; E. T. Gosling (representing associate members); J. R. Stothert (representing associates).

The Royal Society.—The following, according to an evening paper, are some of the 15 newly elected members of the Royal Society:—Mr. Henry R. A. Mallock, an original investigator and experimentalist in various branches of physical science; Dr. David Orme Masson, Professor of Chemistry in the University of Melbourne, for his researches in that science; Dr. Ernest Rutherford, Professor of Experimental Physics, McGill University, Montreal, more especially distinguished for investigations in electricity; Mr. Ralph Allen Sampson, Professor of Mathematics in Durham University, for his contributions to that subject; Mr. John Edward Stead, of Middlesbrough, for his metallurgical researches, especially in regard to the microscopic structure of alloys; Mr. John S. Townsend, Wykeham Professor of Physics, Oxford, author of many researches into the action of electricity on gases; Mr. Alfred North Whitehead, Fellow of Trinity College, Cambridge, who has contributed much to the mathematical relations of viscous fluids.

Municipal Trading.—At the meeting of the Sheffield Chamber of Commerce on May 11th, the petition of the electrical engineers, contractors and fitters of the city against the clause in the Corporation Bill giving power to the T.C. to execute electrical wiring, and to sell electrical appliances for lighting and other purposes, was considered, and a resolution was adopted to the effect that the opposition to the clause was fully justified, and that Parliamentary sanction should not be given to the principle of retail trading by the local municipal authority, or, at any rate, not to any further extent than was given to Brighton Corporation by Sec. 79 of their Act of 1901.

Physical Society.—Dr. Glazebrook, in his Presidential address, recently indicated a possible change of policy in the Physical Society, and this, it seems, is actually taking place, for at the next meeting, on Friday, the 22nd inst., in the rooms of the Chemical Society, Burlington House, at 5 p.m., Mr. J. Stöttner will give an exhibition of Nernst lamps, showing their development from the experimental stage up to the most recent type. We understand that some novelties will be shown which were not on view at the exhibition recently given by Mr. Stöttner at the I.E.E. Those who are interested and are not members of the Physical Society should apply to the hon. sec., Mr. W. R. Cooper, 82, Victoria Street, S.W.

St. Louis Exposition.—We are officially informed that the 500-H.P. Dürr marine boiler, which was taken out of the battery of boilers of the German man-of-war *Sachsen* for exhibition at the Lousiana Purchase Exposition, raised steam for the first time on April 22nd, and operated the 300 H.P. high-speed, automatic, tender-compound engine supplied by the Buffalo Forge Co., of Buffalo, N.Y. This was the first work done by the pre-Exposition power plant. Besides the Dürr boiler and the Buffalo engine there were placed in operation a 200-KW. alternator, built by the Stanley Electrical Mfg. Co., a Sorge-Cochrane feedwater heater and purifier, and two Duplex steam-driven boiler feed pumps, with a capacity of 100 gallons per minute against a boiler pressure of 150 lbs. per square inch, furnished by the National Steam Pump Co., of Upper Sandusky, O. All these machines were entered as exhibits in the Machinery Department. Two Morrin-Climax water tube boilers, with a combined rating of about 700 H.P., supplied by the Clonbrock Steam Boiler Co., of Buffalo, N.Y., have since been installed.

(Continued on page 839.)

THE LONDON COUNTY COUNCIL ELECTRIC TRAMWAYS.

The Construction and Equipment of the Westminster—Tooting Section.

THE formal inauguration of the first completed section of the London electric tramways to-day, by H.R.H. the Prince of Wales, marks an important epoch in the provision of facilities for locomotion in the Metropolis. Although our readers are doubtless familiar with the various steps which have led to the conversion to electric traction of this tramway, a short summary of the history of the undertaking may be of interest, before we proceed to describe the system in detail.

As long ago as 1895 we find the London County Council, led by Mr. J. W. Benn and Mr. J. Burns, scouting the idea of permitting the West End of London to be invaded by the overhead system, in connection with the proposals of the London United Tramways Co. to construct electric tramways along Uxbridge Road. We need not here digress to discuss the wisdom of this attitude; we expressed our views very strongly at the time, and we have never seen reason to modify them in any way. In the following year an important proposal was brought forward by a syndicate, embracing within its scope the whole of the tramways, existing or to be constructed, in the County of London. As the scheme was not entertained by the Council, the details need not be given. On the other hand, in April, 1896, the County Council considered, and later concluded, an agreement with the North Metropolitan Tramways Co. and the London Street Tramways Co., whereby these companies sold their undertaking to the Council, and the former company took a lease of them for 14 years; the lease expires, therefore, in 1910. Under the conditions of the lease, the company is empowered to adopt electric traction, and negotiations are proceeding with the L.C.C. with a view to carrying out the conversion on the overhead trolley system.

In 1898 the London United Tramways Company's Bill for constructing electric tramways in the district west of London was passed into law; this only concerns us inasmuch as the Council insisted on the insertion of provisions to the effect that the small portions of the tramways within the County of London should be worked on the underground conduit system, with the result that these parts of the tramways were omitted from the Act. In October, 1898, the company's application was renewed; the Council then agreed to allow the tramways ending in Uxbridge Road to be reconstructed on the overhead-trolley system, on condition that the one ending at Hammersmith Broadway should be equipped with the underground conduit system, the intention being to experiment with the latter at the expense of the company. (We may mention in passing that the London United Tramways eventually obtained permission to adopt the overhead trolley system on all the three short lines within the county boundaries). Shortly afterwards Mr. Alfred Baker, tramways manager to the Nottingham Corporation, was appointed manager of the London County Council's tramways; and in February, 1899, Dr. Kennedy was requested to report on the experimental use of mechanical traction on the Council's tramways. In the same year the Council drew up a list of tramways, mainly on the south side of the river, which it was proposed to convert to electric traction, for the most part with underground conduits, but partly also with trolley wires and surface contacts.

In June, 1899, Dr. Kennedy submitted a report to the Highways Committee, in which he discussed various systems of mechanical traction, and rejected all except electric traction, with either trolley wires or underground conduits. The former were condemned, mainly on account of the metallic network overhead at important junctions, and the centre slot conduit was recommended for preference, for most of the tramways south of the Thames. For the lines running out to suburban or semi-rural districts, the choice was left open. It was recommended that a length of five or six miles of route should be experimentally equipped with the conduit system.

The cost of so equipping the whole Metropolitan system of 200 miles of single track, including the cars and power stations, was assumed to be £3,000,000, or at the rate of £15,000 per mile; while the possibility of the cost being in excess of this figure was foreshadowed, Dr. Kennedy urged that this should not deter the greatest city in the world from carrying out an underground system which would be worthy of the city, and permanently satisfactory.

The report was adopted by the County Council, and Dr. Kennedy was appointed to design and carry out the work in connection with the experimental line.

Towards the end of 1900 the Council decided to appoint a permanent electrical engineer to supervise generally the reconstruction of the whole of its tramways, apart from those with which Prof. Kennedy was dealing. In accordance with this resolution, Mr. John H. Rider, consulting and resident engineer for electric tramways and lighting to the Plymouth Corporation, was appointed in February, 1901.

Tenders were invited in the same year for two steam dynamos and two steam alternators, of 1,500 KW. each, with auxiliary plant, and in November the contracts were awarded to Messrs. Dick, Kerr & Co., Ltd., using their own generators and Ferranti engines. As the competition was open, and 372 tenders in all were received, the success of the British firm in securing the whole of the work was regarded as a noteworthy achievement. In the following year the contract for the reconstruction of the track was placed with Messrs. J. G. White & Co., Ltd. The whole of the plant mentioned above, and of the roadwork on the Tooting section, was carried out to the specifications of Dr. Kennedy.

An important step was taken in January last year, when the Council adopted a recommendation of the Committee to convert several additional routes in South London at an estimated cost of £644,350, or £33,000 per mile. This figure included more generating plant and car-sheds than were required for the 19¼ miles of track concerned, but was exclusive of the cost of the generating station at Greenwich.

In April, 1902, the first contract for cars was placed with Messrs. Dick, Kerr & Co., Ltd. The order included 100 cars for the Tooting section, and was awarded to this firm by Dr. Kennedy largely on the score of the excellence of the motors offered. In July last an extension order for four miles of track was placed in the hands of Messrs. J. G. White & Co. as a matter of urgent necessity.

The total cost of the Tooting section was estimated at £623,500 in February, 1901; in July last year this was increased to £981,497, of which £171,000 was allotted to the generating station at Greenwich, £27,350 for a temporary station at Loughborough Junction, and £85,000 for the Clapham car-sheds. An additional sum of £152,000 was voted for car-sheds, workshops, &c., at New Cross.

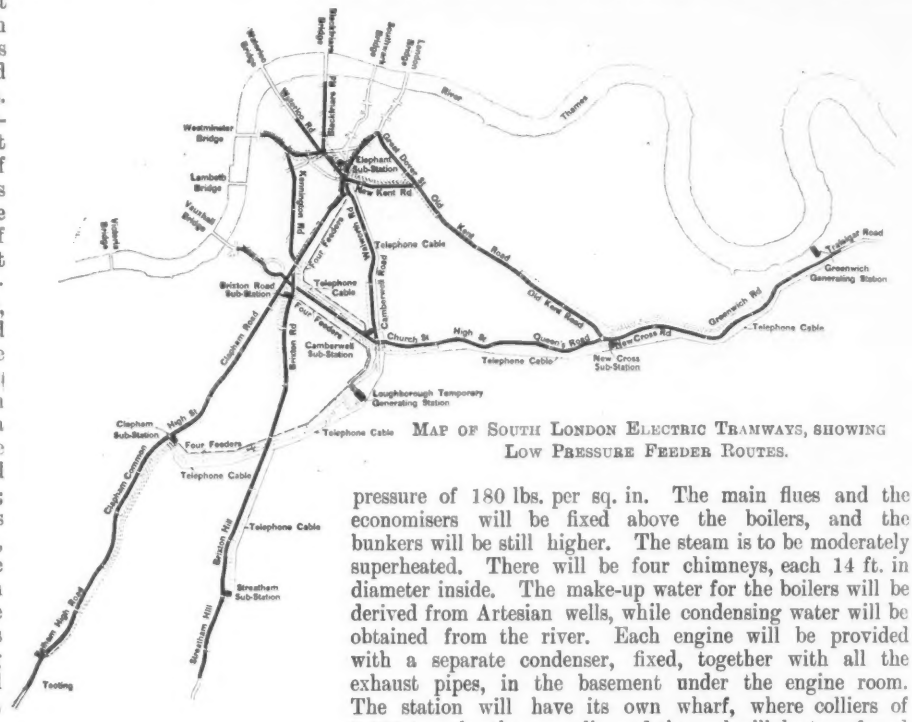
The present position of affairs is as follows:—Practically the whole of the tramways on the north of the river have been purchased by the Council, and have been leased until the year 1910. As regards the south side, the Council holds the whole of the lines which belonged to the London Tramways Co., and has let contracts for the conversion of all of these, part of which constitutes the Tooting branch, which is to be opened to-day. The Council last year bought the South-East Metropolitan Co.'s line from New Cross Road to Rushey Green, and in November last took over the South London Co.'s Tramways, which run from Westminster, and London Bridges to Battersea and Wandsworth. The Council is negotiating for the purchase of the lines running from Woolwich to Erith. The section at present completed comprises tramways starting from the bridges at Westminster, Blackfriars and Waterloo, joining at the Horns, Kennington, and running from there to Tooting. The total length of this section is 16½ miles of single track.

Four years ago Dr. Kennedy was appointed to report on the equipment of a section of tramway with the conduit system for experimental purposes; the County Council chose the Tooting section for this purpose, but the work long ago ceased to be considered "experimental." It will be

within the memory of our readers that the section of conduit track which was exhibited at the Agricultural Hall in 1900 by the British Westinghouse Co. was bought by the Council and relaid at Camberwell, for the purpose of demonstrating the practical operation of the system, and convincing the various borough councils of its many advantages; for the County Council has suffered many things at the hands of its subordinate local authorities, who have not hesitated to exercise their right of veto upon the Council's proposals, with or without reason. At the same time a skeleton conduit was exhibited on the surface, which was designed by Dr. Kennedy for the County Council's lines. This design was severely criticised by the technical press, but as the result of the competitive tendering, the proposals of Messrs. J. G. White & Co. were accepted, to build the line in accordance with Dr. Kennedy's specifications. As Mr. A. N. Connett, the chief engineer of that firm, has had a greater experience in the construction of electric and cable conduits than probably any other engineer, the choice was a wise one.

The new conduit is 2 ft. deep — 2½ in. deeper than the original design, and the insulators are carried by brackets from the slot rails, in accordance with the practice which has been universally adopted in modern constructions. The yokes are of horse-shoe shape, set at short intervals, and the body of the conduit and track is of concrete. The whole length of 16½ miles of track has actually cost £13,660 per mile, including all special work, paving, the removal of pipes and other obstructions from the roadway.

Recent allegations in the daily press as to a cost of £40,000 per mile for this work are based upon mistaken premises; for, while only 16½ miles of track have been equipped, the contracts which have been let in connection therewith provide for the operation of many times this length, work being taken in hand which will bear fruit only when a much larger system is completed.



MAP OF SOUTH LONDON ELECTRIC TRAMWAYS, SHOWING LOW PRESSURE FEEDER ROUTES.

It was originally intended to supply these lines, and all the rest on the south side of the river, from one power station at Camberwell—a central site, it is true, but one which possessed facilities for the supply of neither feed water nor condensing water; while coal and ashes would have been dealt with by railway transit only.

When Mr. J. H. Rider was appointed electrical engineer to the County Council Tramways in February, 1901, foreseeing the enormous future development of the system, he found it necessary to give very careful consideration to the question of the best means of supplying, not an isolated section, but the tramways of the whole of the County of London. A cursory inspection of the map of London will at once show that the growth of the Metropolis has, to some extent, followed the course of the river, the county forming a huge elliptical figure, with its greater axis east and west; Mr. Rider, therefore, recommended the Highways Committee to place two stations, roughly speaking, at the two foci of the ellipse, and both on the river, so as to secure the shortest length of feeders, and the best possible facilities for the supply of coal and water. One of the power stations will be located at Greenwich, close to the Old Trinity Hospital, and the other in Pimlico, on the north side of the river. From Greenwich, the mains to supply the tramways of the north-east district will be taken through the Blackwall tunnel; the Pimlico station being already on the north side, is favourably placed to supply the west end. The importance of this amended scheme may be estimated from the fact that each station, when in full work, will burn about 600 tons of coal per day; as this can be delivered by steamers, the difference in the freight charges, between railway and water carriage—amounting to probably 3s. per ton—will be saved, representing an economy of no less than £30,000 per annum on this item alone. The economies to be derived from the use of condensing plant, easy removal of ashes, &c., need no emphasis. The first station to be put in hand will be the one at Greenwich, where current will be generated at 6,600 volts three-phase, 25 cycles per second, and transmitted to sub-stations.

One-half of the projected power station will be erected in the first instance. The complete scheme provides for a building 427 ft. long × 160 ft. wide. The engine house will contain eight generating sets, each consisting of a vertical-horizontal engine of 5,000 H.P., similar to those installed in the 74th Street station, New York, coupled direct to an alternator. The boiler house will receive 48 boilers of the water-tube type, of which the first section—16 Stirling boilers—has been ordered, working at a steam pressure of 180 lbs. per sq. in. The main flues and the economisers will be fixed above the boilers, and the bunkers will be still higher. The steam is to be moderately superheated. There will be four chimneys, each 14 ft. in diameter inside. The make-up water for the boilers will be derived from Artesian wells, while condensing water will be obtained from the river. Each engine will be provided with a separate condenser, fixed, together with all the exhaust pipes, in the basement under the engine room. The station will have its own wharf, where colliers of 1,000 tons burthen can lie, and the coal will be transferred by machinery direct from the hold to the bunkers, whence it will be fed to the boilers by gravity. Ashes will be disposed of in an equally simple and economical way. The switchgear will occupy two galleries in a recess on the side of the engine room opposite to the boiler house, and will be of special design to meet the severe conditions of large powers at high pressures.

The station buildings were completely re-designed to Mr. Rider's requirements by Mr. W. E. Riley, architect to the London County Council, as it was found that large economies could be effected on the original designs, both in the construction and in the working of the station.

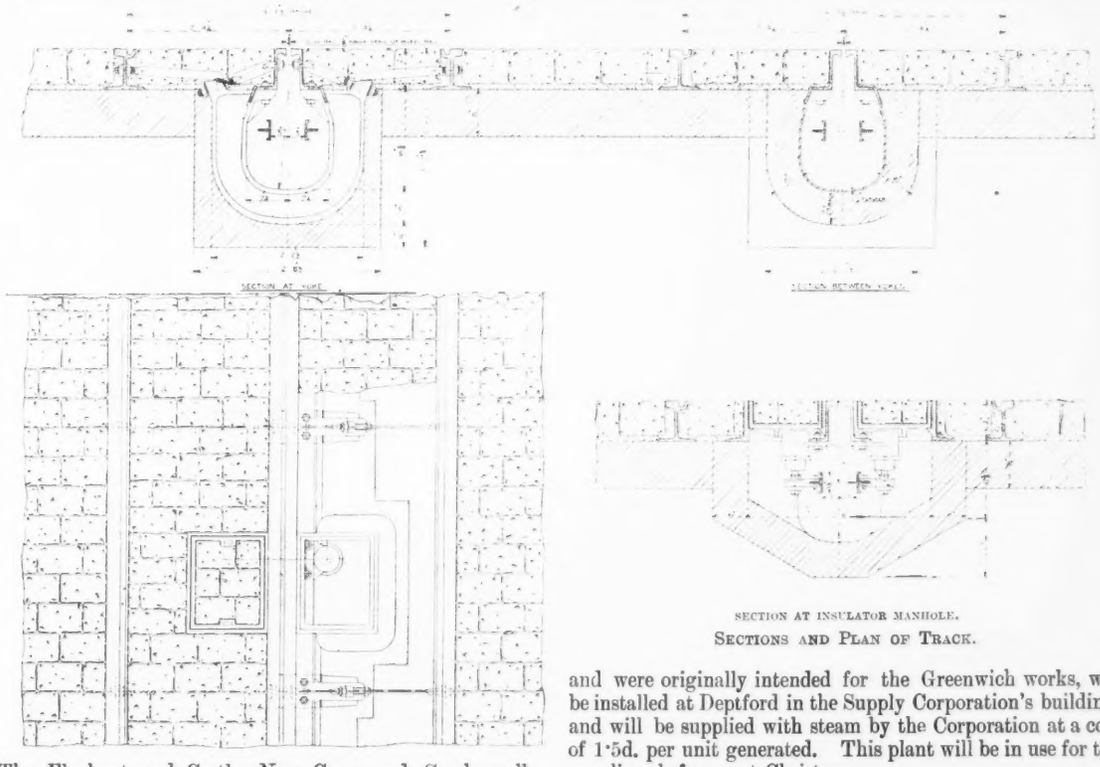
From the power station a separate feeder will run to each of the sub-stations, which are designed to supply the whole of the electric tramways in South London, existing or to be constructed. The first of these sub-stations will be located respectively at the Elephant and Castle, at the end of the cable tramway in Brixton Road, at Clapham Common, at Streatham, at Camberwell (where the offices and a car depôt are situated), and on a large site, called Fairlawn, at New Cross, where there will be a car-shed. The high-pressure cables running to the sub-stations have been ordered from Messrs. Siemens Bros. & Co., and are of the paper-insulated lead-covered three-core type, each core having a cross-section of 0·15 sq. in. A copper sheathing of 0·075 sq. in. cross-section surrounds the cable just inside the lead covering, and will be connected with earth, in accordance with the require-

ments of the Board of Trade. These cables, as well as the distributing cables from the sub-stations, will be drawn into stoneware ducts similar to those used by the Post Office in laying the telephone cables, and 1,000,000 have been ordered from three contractors.

Besides the direct connection with the power station, an inter-connecting cable of the same type, but half the size, will be laid from one sub-station to another all round, so that each sub-station can be fed from two others in case of need; this arrangement provides ample security against breakdown.

[Photo by R. Thiele & Co.]
DR. A. B. W. KENNEDY, F.R.S., M.I.C.E., &c.
Consulting Electrical Engineer to the L.C.C. Tramways.

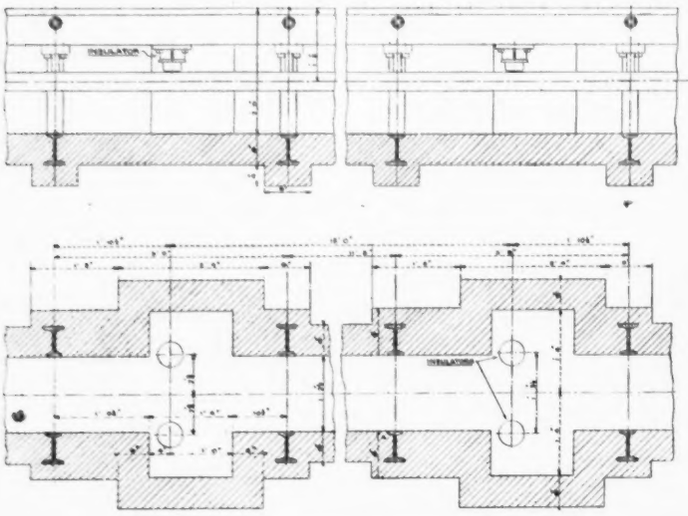
MR. J. H. RIDER, M.I.C.E., M.I.E.E., &c.
Electrical Engineer to the L.C.C. Tramways.



SECTION AT INSULATOR MANHOLE.
SECTIONS AND PLAN OF TRACK.

The Elephant and Castle, New Cross and Camberwell sub-stations will be equipped with motor-generators of 300 KW. each, which have been ordered from Messrs. Dick, Kerr & Co.; probably machinery of a larger size—500 KW.—will be called for in future orders. The three sub-stations above-mentioned will be used to feed the lines about to be equipped—namely, those running from the Elephant to Greenwich *viâ* New Cross and Old Kent Road, and to New Cross *viâ* Walworth and Peckham. As these will be ready before the main power station, arrangements have been made with the London Electric Supply Corporation to supply power from their station at Deptford in the meantime. The two three-phase generators of 1,500 KW. each, which are being built by Messrs. Dick, Kerr & Co., and were originally intended for the Greenwich works, will be installed at Deptford in the Supply Corporation's building, and will be supplied with steam by the Corporation at a cost of 1·5d. per unit generated. This plant will be in use for the new lines before next Christmas.

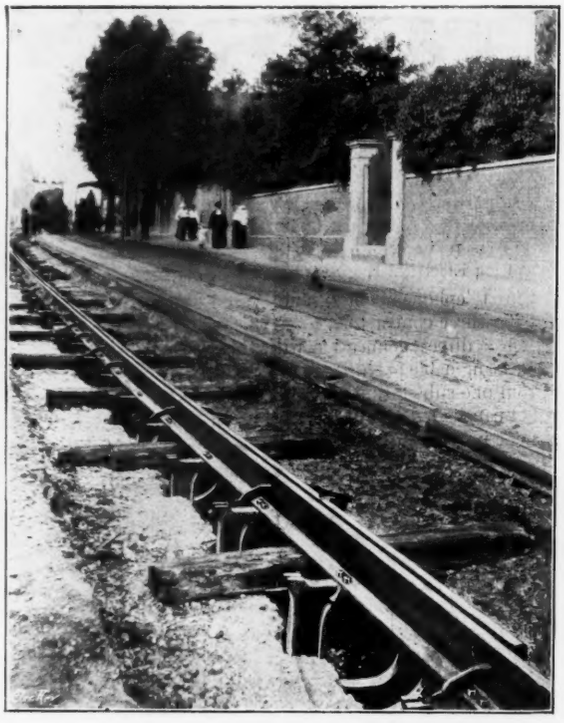
For the operation of the Tooting line, which is of more immediate interest, a similar arrangement has been made with the South London Electric Supply Corporation. A



Vertical and Horizontal Sections of Conduit.

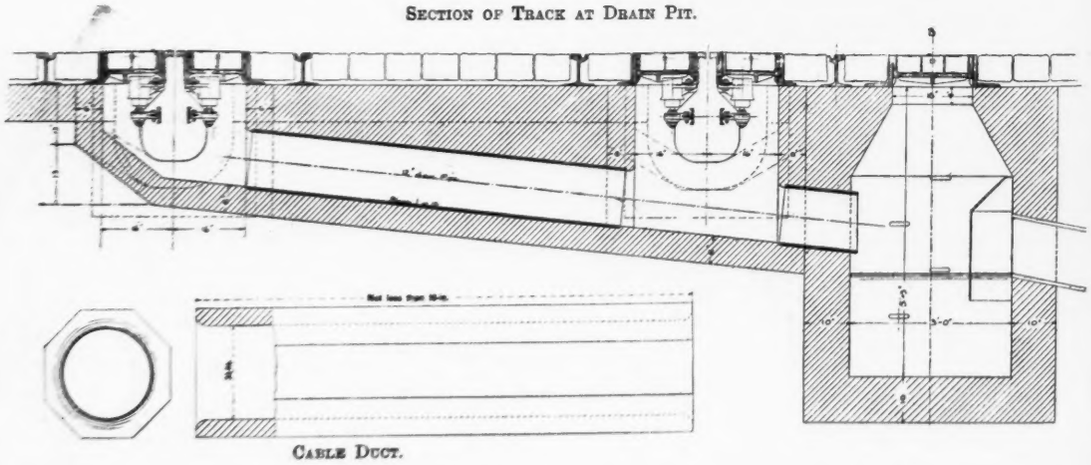
house two 1,500-kw. direct current generators (which also were originally ordered for the Greenwich works), built by Messrs. Dick, Kerr and Co. The engines were made by Messrs. Ferranti, Ltd. These are supplied with steam by the Corporation, which has put down extra plant in the shape of two Stirling boilers for the purpose. The tariff here is 1·4d. per unit generated. The generators work at 550—625 volts, and supply power to the sub-stations at Clapham, Brixton Road and the Elephant, the last of which will for some time have to do double duty. It will be understood that no motor-generators are required at present in the sub-stations, the incoming feeders from Loughborough Junction being connected direct to the switchgear, which is all of the direct current type. When the high-pressure supply becomes available, these feeders will be disconnected and replaced by the cables from the motor-generators. The feeders will then be withdrawn from the ducts and used elsewhere as distributors. They are paper-insulated and lead-

Excavation Ready for Yokes.



Slot Rails and Yokes in Position.

Section of Track at Drain Pit.



Cable Duct.

temporary building has been erected adjoining the Corporation's generating station at Loughborough Junction, to

covered, two in number, each of 0·75 sq. in. cross-section, and were made by the British Insulated Wire Co., Ltd.,

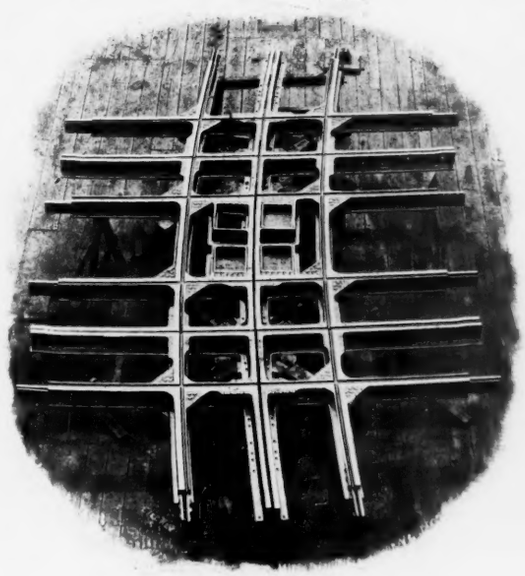
who received the contract for all the low-pressure cables on the south side of the river. The cost of the whole of the high and low pressure cables, including drawing into ducts laid by the Council, amounted to £90,000. The ducts themselves,

Conduit Completed.

Track Completed and Paved.

with the laying, will cost about £50,000, but provision has been made for great extensions of the cables in this section of the work. The cables will suffice for the supply of 50 miles of single track, feeding both poles.

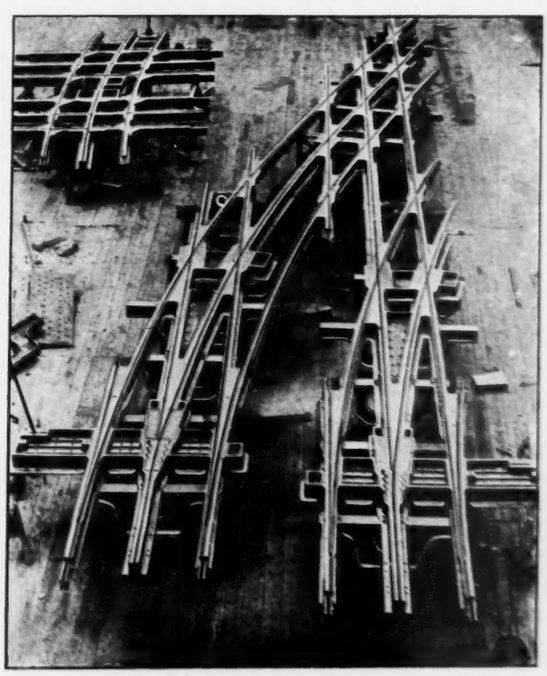
Having thus briefly outlined the scheme as a whole, without which many points which will be referred to would seem obscure, we may proceed with the details. Naturally, the track first claims attention, as it is in this feature that the County Council's tramways differ most from other electric tramways which have already been constructed in this country. Although the first practical conduit tramway



Special Work: St. George's Circus and Blackfriars Road.

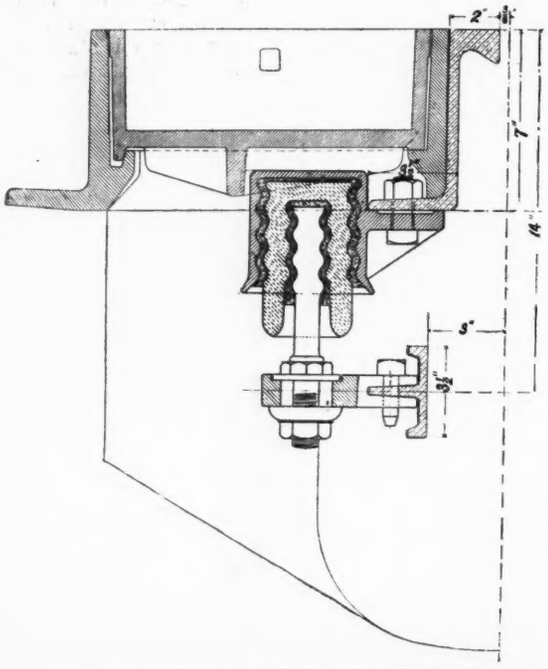
was laid down in England—at Blackpool—in 1885, by Mr. Holroyd Smith, and was so far successful that it was in operation until 1899, when the constant difficulties set up by the sand and flooding by the sea led to the substitution of the overhead trolley system, the conduit has been developed entirely abroad; and until the short section of conduit tramway at Bournemouth was opened in January last, this mode of supplying power to tramcars was not represented in this country. The Bournemouth tramways were also constructed by Messrs. J. G. White & Co., and naturally resemble the London lines in many respects, the main difference being that the former have the slot in one of the track rails, while in the latter the slot is in the centre of the track.

The construction of the track is clearly shown by the



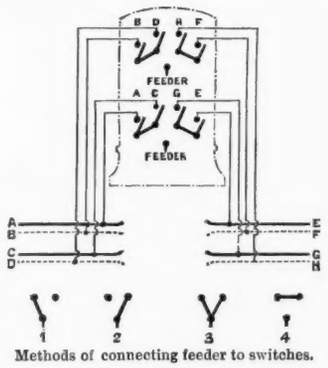
Special Work: Kennington Road and Westminster Bridge Road.

accompanying drawings and photographs. The gauge of the line is standard, 4 ft. 8½ in.; the running rails weigh 102 lbs. per yard, and are of the usual girder type. They



Section of Slot Rail, Insulator, and T-rail.

rest directly upon the surface of a concrete foundation, which is generally 8 in. deep, and normally extends 18 in.



Methods of connecting feeder to switches.

Diagram of Connections in Feeder Switch Pillar.

A, B, C, D, &c., conductor rails and corresponding terminals.
The numbered diagrams show the four methods of coupling up either of the two feeders by means of links, viz.:—

1, Feeding both tracks towards the left.
2, Feeding both tracks towards the right.
3, Feeding both tracks in both directions.
4, Feeder disconnected, T-rails coupled through.

beyond the rails on either side of the roadway. The slot-rails are of the "Z" type, with a lip to allow surface

Views of Track and Special Work before Paving.

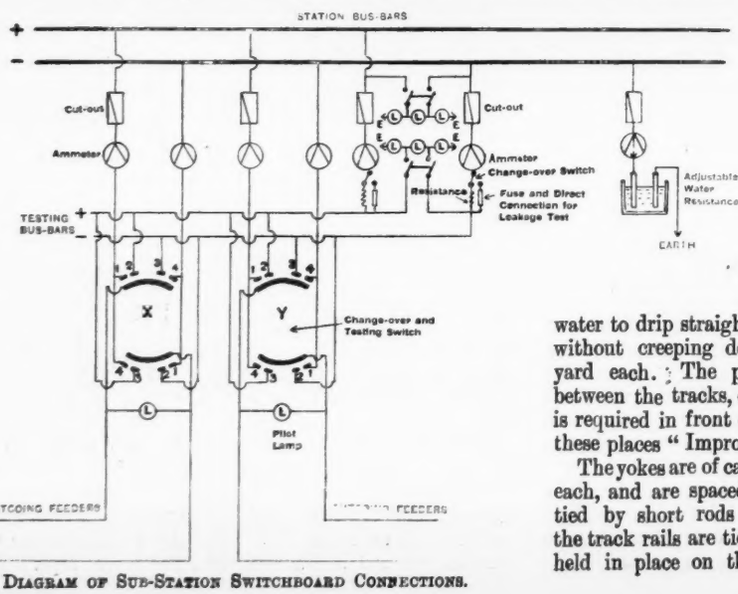


Diagram of Sub-Station Switchboard Connections.

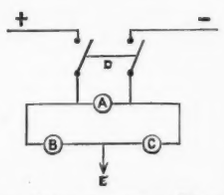


Diagram of Connections of Test Lamps.

water to drip straight through to the bottom of the conduit, without creeping down the sides; they weigh 62½ lbs. per yard each. The paving consists of granite setts in and between the tracks, except where a special noiseless pavement is required in front of churches, theatres and hospitals. At these places "Improved Sanitary Block" is used.

The yokes are of cast-iron, of heavy section, weighing 160 lbs. each, and are spaced at 3 ft. 9 in. centres; the slot rails are tied by short rods to the outer lugs of every yoke, while the track rails are tied to every other yoke by means of rods held in place on the yokes by the slot rail tie-rods. At

intervals of about 40 yards there are sumps for drainage, connected with both tracks by a 12-in. pipe, and with the sewers by a simple trap. A similar sump is placed at all special work.

The only part of the conduit which is deeper than two feet is the switch pit, which is provided at each piece of special work. This takes the place of the ordinary drain pit, and is deep enough to allow a man to get into it—1 ft. deeper than the tube. The latter is cast around a wooden form, which is fixed between adjacent yokes; when the concrete has set, the boards are removed, leaving the conduit in its finished condition, except at the bottom, which is "floated" with thin cement to give a smooth surface. The wall of the conduit is about 6 in. thick, except at the yokes, where it is made 4 in. thicker at the sides and 4 in. deeper, to enclose the yoke.

The insulators are spaced 15 ft. apart, between yokes, in manholes with removable covers, the latter being filled with material similar to the paving, as shown in the drawings. The insulator used consists of a porcelain body cemented into a cast-iron cap, the surfaces of both being corrugated to assist the grip of the cement. Inside the porcelain, and similarly cemented, is a wrought-iron bolt. The insulator is provided with an apron on the cap to shed water, and another one on the porcelain. Each insulator is assembled at Messrs. J. G. White & Co.'s works in London, in a rack which holds all the parts in exact adjustment whilst the cement is setting. For this reason no vertical adjustment of the insulator is necessary; horizontal adjustment is ingeniously provided by an eccentric washer on the stem of the insulator, which fits into a recess turned in the top of the cast-iron clip that supports the conductor rail. By rotating the washer more or less, the position of the rail can be accurately adjusted. The cap of the insulator is bolted direct to the base of the slot rail. The web of the T-rail is fixed in the jaws of the clip by a taper pin dropped in from above, and not otherwise secured; this facilitates the removal of the T-rail, should this be necessary for any reason. A joint is provided at the end of each rail, $\frac{1}{4}$ in. wide; the gap is bridged over by two flexible copper bonds, with solid ends hydraulically pressed into the web. Each conductor rail is 30 ft. long, and weighs 22 lbs. per yard; the joints in the two rails are staggered. At the joints the rails are held in jaws of special design, there being two pins, one to each rail end. The conductor rails are firmly held with their vertical faces 6 in. apart, and with their centres 14 in. below the top of the slot rails, leaving a clear space of $8\frac{1}{4}$ in. between the lower edges of the rails (which are $3\frac{1}{2}$ in. deep) and the bottom of the conduit. The extreme width of the conduit is $14\frac{1}{2}$ in. inside.

Brixton Road Sub-Station: Low-Pressure Switchboard.

The slot rails and the crown of the roadway are raised $\frac{3}{8}$ in. above the running rails, to shed water from the slot; the running rails are suitably drained at intervals. The slot is only $\frac{3}{4}$ in. wide, and therefore has practically no detrimental influence upon the ordinary traffic.

At all special work, and at the section insulators, which occur at intervals of half a mile, and are also feeding points, a plough hatch is provided; this is of very simple construction, consisting merely of two narrow cast-steel lids forming the sides of the slot, dropped into seats. The hatch is always placed at the centre of the gap between the rail ends, and as this gap is 2 ft. long, the plough is necessarily dead when it has to be handled. The ends of the T-rails at section insulators are splayed apart, to enable the plough to enter easily, and are supported at these points by a pair of insulators instead of one, to provide against possible shocks from the plough.

At points and crossings the T-rails are interrupted altogether, the car having to drift through without current. The break is not usually longer than 8 ft., though at the worst crossings it reaches 12 ft. This is one of the disadvantageous features of the conduit system which cannot be avoided in practice. At complicated junctions repeated breaks occur, the lamps in the car go out, and the car may have to be stopped while drifting, in which case there is nothing for it but to have recourse to muscular effort, or the assistance of another car, to move it on until connection is re-established. The rule is to shut off the power altogether while passing through switches.

The whole of the special work has been carried out for Messrs. J. G. White and Co. by the Lorain Steel Co., and consists of hardened steel, with special steel insets where the running rails cross one another and where they cross the slot. The track rails at switch points are both provided with movable tongues, which are coupled together and with the slot tongues beneath the road surface, and are operated by the same lever; at all facing points an attendant is stationed, while the cars run through trailing points as usual. The slot switches are so designed, with serrated edges, that the slot is at no part wider than $\frac{3}{4}$ in. at any time.

The reconstruction of the track presented many difficulties, not the least of which was that of breaking up the old track, which was extremely well made. The most satisfactory method was found to be to jack up the old concrete roadbed for a distance of 50 or 60 ft. *en bloc*, and then to smash it up with spikes and sledges. After the *débris* was removed, the excavation for the conduit was made and graded, with chases for the yokes. Next, the slot rails and tie bars were bolted to the yokes, and the latter temporarily supported with cross sleepers while the slot rails were levelled. The

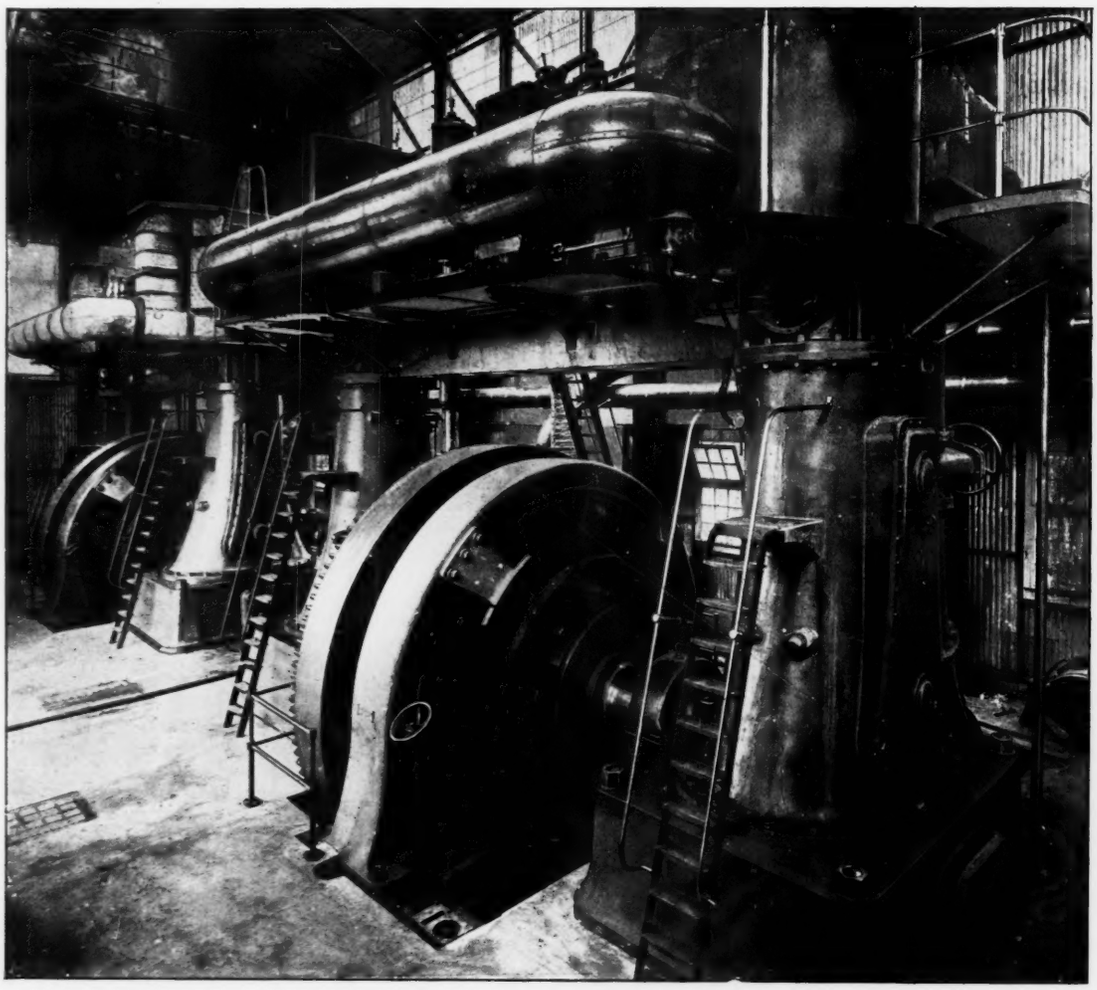
yokes were then fixed in position by partially forming the bottom of the tube round the yoke with 5 to 1 concrete; the wooden forms for the tube were secured between the yokes with wedges, and the concrete was rammed to form the tube. Special centres were used to form the insulator boxes. The track foundation was composed of 7 to 1 concrete.

The next process was the plate-laying, which differs considerably from ordinary tramway construction; not only have the track rails to be correctly curved and gauged, but also the slot rails and the T-rails must be kept concentric with the track and true to gauge. Lastly, the insulator frames and covers were set, and the only remaining operation was to pave the roadway.

The T-rails were introduced into the conduit through gaps left at suitable intervals—generally the sumps for drainage answered this purpose. The T-rails were suspended by means of special tools from small carriages running on the tables of the slot rails, and were thus carried to the point where they were required; there they were secured to the insulators, and bonded by means of a special hydraulic press, which operated through the opening of the insulator box.

During the process of reconstruction, the horse traffic had to be kept going, without interruption; this was accomplished by means of long lengths of temporary track laid alongside the track under conversion, to maintain the double track service. The rails used for this purpose were of a special flat section, which provided the groove for the flange of the car wheels, while it offered no serious obstruction to the ordinary wheeled traffic.

All the cars are fitted with the sliding plough devised by Mr. Connett; this is carried on a pair of parallel bars at right angles to the car, and is free to move sideways to adapt itself to slight eccentricities of the slot. By an ingenious extension of the idea, the bars are clear to the ends, so that if by chance the plough were to take the wrong path at a switch, it would simply slide along the bars as the car went on, until it dropped off outside the car. No harm would be done, and the plough could be replaced at the hatch without delay. Further, this device enables the slot to be diverted to the side of the track where necessary; such occasions arise at the junction with the cable routes at Kennington, and in the car-sheds. There is naturally a difficulty in using the centre slot in the sheds, as the conductors obstruct the pits. The most practicable alternative to the use of the plough for moving the cars in the sheds would be an overhead trolley with a length of cable, connected with the car by means of a plug and socket; and this has been in use for some months at the training school, which is carried on at the cable power house and depôt at Streatham Hill. A better plan, however, is to divert the slot to the side of the pit, protecting the workmen from the conductor rails by a wooden conduit, one side of which is hinged to admit of ready access. Thus practically the whole width of the pit is left free for work on the motors and trucks.

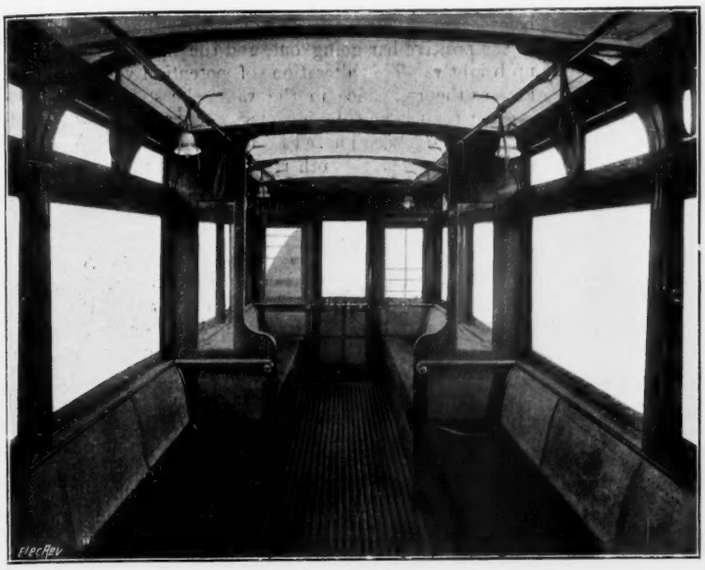


Generating Plant in Temporary Power Station at Loughborough Junction.

The junction with the cable line, referred to above, is of interest, as it is unique in electric tramway practice. It is intended to run the electric cars over the cable route until the latter is reconstructed, exchanging the plough for a gripper at the junction; to effect this easily and quickly, the two conduits have to be built side by side, under very difficult conditions. This, however, is apart from our present subject.

On the footpath opposite each of the section insulators there is a feeder pillar, equipped with eight switches and a system of link couplings; from this it results that the boxes are somewhat larger than those to which we are accustomed in connection with trolley systems. The eight switches are necessitated by the fact that both poles have to be controlled, there being eight T-rail ends opposite each

box. The arrangement of the switches will be best understood from the diagram given on p. 832; it will be seen that by means of the links it is possible either to connect the feeder cables to the switches, and so to the T-rails, feeding either pair in either direction, or both at once, or to connect the sections of the T-rails through, and lay the feeders idle. These boxes were supplied by the British Insulated Wire Co., Ltd., to Mr. Rider's designs.

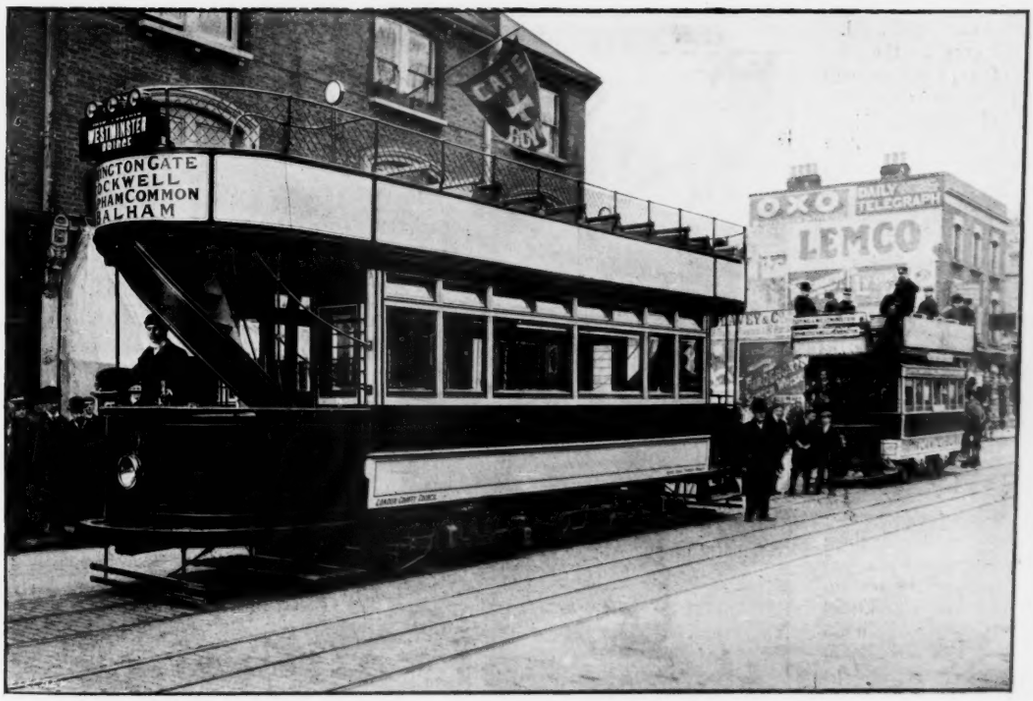


Interior of Car.

The feeders are carried in earthenware ducts laid in concrete, with a surrounding layer 4 in. thick. The ducts are laid between the tracks under the roadway, except on the length between Clapham Common and Tooting, where they are laid under the sidewalk. At this part, too, the tracks are laid 8 ft. 0½ in. apart to centres, instead of 9 ft. 0½ in., as elsewhere. The minimum number of ducts provided is four; the number varies according to requirements, there being a maximum of 32 for a short distance near the Elephant and Castle sub-station. Only ten of these ways are used for the Tooting lines, the other 22 being laid for the service of future roads. The sizes of the cables also vary, according to the distance traversed, and the density of the traffic expected; for example, London Road receives cars from all parts of the south side, and the load here is six or seven times as heavy as at Clapham, for instance. The cross-section of the cables varies, therefore, from 0·15 to 0·75 sq. in. An important difference between the conduit and the trolley system is here met with: both conductors are insulated from earth, but either of the conductor T-rails may develop an earth fault. Hence it is desirable to be able to reverse the polarity of the conductors, so that all faults of this kind may be brought to one side of the system, until the traffic ceases and the fault can be remedied at night. For this reason each half-mile of conduit has to be separately fed from the sub-station, where the reversing-gear is situated. All the cable work has been carried out to Mr. Rider's specification. Normally each pair of feeders feeds only in one direction—that is to say, each section of track is fed from one end only, in order to simplify the operation of reversing.

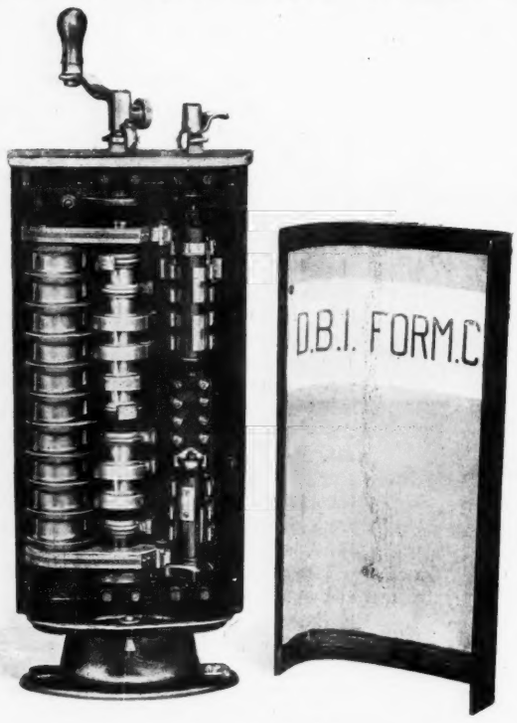
We may now proceed to describe the switchgear in the sub-stations. At present the latter are equipped only with low-pressure gear, as already explained, the motor-generators not being installed as yet. Eventually there will be three kinds of switchgear in each sub-station—high-pressure switchgear to control the in-coming feeders and alternating-current motors, low-pressure gear for the generators, and low-pressure gear for the distributing cables and reversing gear. The last-mentioned has been put in place. We give on p. 833 a view of the switchboard at the Brixton Road sub-station, and on p. 832 a diagram of connections.

The sub-station switchboards were made to the designs of Dr. Kennedy, by Messrs. Cowans, Ltd. The panels controlling the feeders are all exactly alike; each of them serves both poles, and consists of an enamelled slate slab, carrying at the top an edgewise circuit breaker of Messrs. Cowans' design, on the positive pole only, an ammeter on each pole,



Bogie Car and Horse Car

of the moving-coil type, made by Messrs. Nalder Bros. and Thompson, a double-pole main and reversing switch, and a pilot light consisting of three lamps in series. These feeder panels are in a continuous length, numbering 6 to 10, according to the



Controller with Cover Removed.

district served; beyond them will come the boards referred to above. At the other end, at right angles to the main board, is fixed a testing board fitted with three indicating ammeters, two recording voltmeters, and one recording ammeter, and two sets of test lamps. A voltmeter of the illuminated dial type surmounts this board. By the side of the testing board is a regulating handle for controlling a water resistance, which is used normally for keeping the negative pole of the system at earth potential.

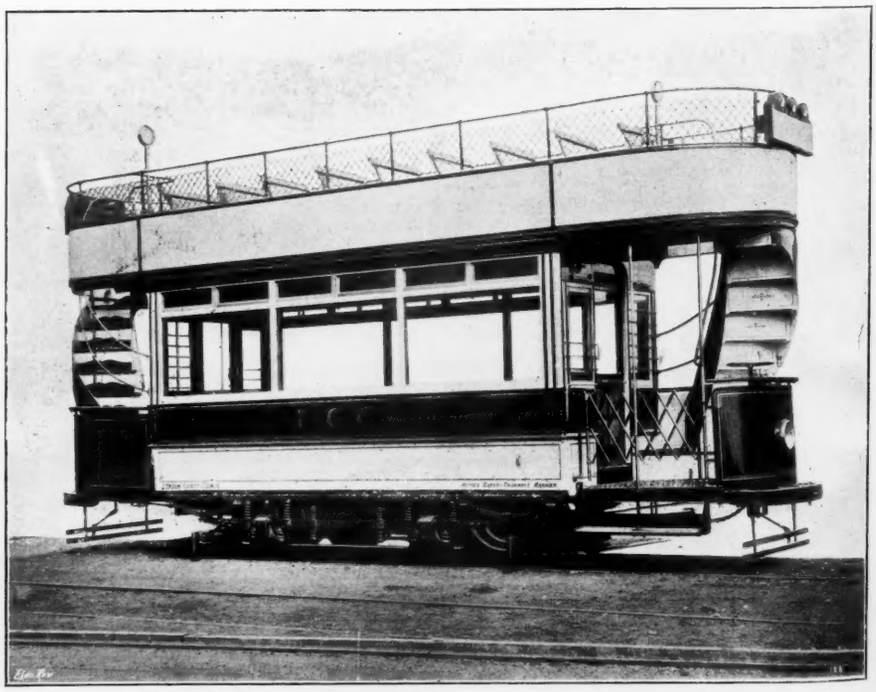
A reference to the diagram of connections will help to make clear the method of working. Each pair of outgoing feeders passes through a double pole change-over and reversing switch (X, Y, &c.), which is provided with working contacts, 1, 4, and also with test contacts, 2, 3, in each position.

The contacts numbered 1, 4, are connected through two ammeters and one circuit breaker with the main bus-bars; contacts 2, 3 are joined to the testing bus-bars, which are connected with the main bars through ammeters and circuit breakers on the testing panel, and resistance coils, as shown. Two rows of bulkhead fittings, each containing a group of three lamps in series, are fixed on the testing panel; the connections of these are best understood from the small diagram on p. 832.

It will be seen that in each row the two outer lamps, B and C, are connected as in Hopkinson's earth test, while the centre lamp, A, is directly across the bus-bars. Two of the upper lamps will burn brightly, but as the negative bus-bar is normally earthed by the water resistance, the lamp on that side will not be alight until the earth is removed. Should a heavy earth come on the positive side on any one of the feeders, the positive pole is brought down to earth potential, and the negative lowered to 500 volts below earth. This is at once indicated by the lamps connected to the positive bar going out, and the negative bar lighting up brightly. This alteration of potentiality is possible so long as the resistance in the water rheostat is sufficient to prevent the passage of an excessive current. The defective section can then be hunted up by momentarily disconnecting one feeder after the other, the lamps returning to their normal condition as soon as the faulty section is switched off. This section can then be reversed, putting the earth on the negative side. Thus if one of the feeder circuit breakers come out, the attendant places the reversing switch in connection with the adjacent testing contacts, whereby the lower row of lamps is brought into operation. If it should appear from the brightness of the two outer lamps that the positive feeder is earthed, the attendant next closes the switch on the opposite side. Thus, so long as only *one* of the T-rails in any half-mile section is earthed, all the faults can be put on one pole, and the cars can be kept running without difficulty. The lower row of lamps must always be made to light up so as to correspond exactly with the upper row of lamps, before the section is switched in. The testing circuit is found to work satisfactorily, and enables faults to be detected without dangers from arcs which might be caused by switching straight on to a short circuit. It also enables the switchboard attendant to watch the behaviour of a fault, and as soon as the line is cleared to again switch it on.

The plant which has been installed at the Loughborough temporary power station consists of the two 1,500-KW. direct-current machines, which are coupled direct to Ferrranti vertical engines. The generators are of the 12-pole type, compound-wound, and when running at a speed of 150 revolutions per minute develop at full load 2,400 amperes at 625 volts. The design of these machines is in general accordance with the standard practice of Messrs. Dick, Kerr and Co., Ltd.

The cast-iron magnet frame with its field-magnet bobbins weighs 30 tons. The frame is divided horizontally; but, in order to provide easy access to the armature and to the lower field coils, it is possible to slide the whole of the field

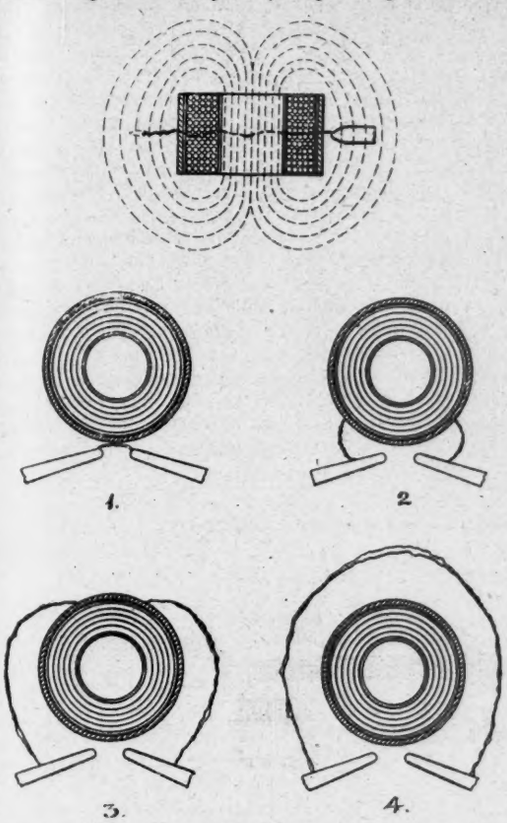


Single-Truck Car.

frame axially sideways, and thus disclose both the armature and the field coils. The pole-pieces are cast into the magnet frame; they are made of laminated steel, and are dove-

tailed at each end. The laminations are held together by steel end pieces bolted securely together.

The field bobbins are held in position by means of detachable pole-shoes, especially shaped to give an efficient



Section of Arc Breaker, and Diagrams Showing the Process of Disruption.

distribution of the magnetic flux. The series coil is wound at one end of the bobbin, the shunt coil occupying the remainder of the space. Both series and shunt windings are insulated with special material of high quality, and each field coil is tested before it is put in position, with a pressure of 2,500 volts.

The armature core is carried on a cast-iron spider formed of double arms carrying the rim, which is divided so that shrinkage strains are avoided. The hub has a very large bearing surface on the shaft, and is keyed in place; it is also extended to carry the commutator spider. The armature core is made up of laminated punchings of high-class steel, which are thoroughly annealed, and are japanned in order to prevent the formation of eddy currents. At intervals of 4 inches spacing discs are inserted between the laminations; this arrangement gives air ducts passing from the centre of the machine to the periphery of the armature. The laminations are clamped in position by means of special cast-iron end rings, the ring furthest away from the commutator being designed to carry the end of the armature coils. The armature coils are insulated with a combination of yarn and Japanese paper with sheet mica, and are insulated from the core by layers of the same insulating material combined with oiled linen tape. The coils are former-wound, and are interchangeable. There is, of course, no joint in any coil, except at the points where it is attached to the commutator.

The commutator bars are of hard-drawn copper, and are finished accurately to gauge. The complete commutator is carried on the extended armature hub already referred to, and is securely keyed to this. Balancing rings are provided, which are carried on one of the armature end-plates nearest to the commutator. The brush-holders are so designed that the current does not pass through any moving joints or tension springs; the tension can be applied to the brushes without lifting them, and any brush can be removed without disturbing the others. Movement of the brushes about the commutator is obtained by means of a hand-wheel and screw.

The following are the leading particulars of the engines supplied by Messrs. Ferranti, Ltd.:—

The cylinders are 31 and 62 in. in diameter, with a stroke of 30 in.; the piston rods are 6½ in. in diameter. The main bearings are 18 in. in diameter and 36 in. long, the crankpins 11½ in. × 14½ in. long, and the cross-head pins 9 in. × 13½ in. long.

The guaranteed steam consumption per I.H.P.-hour is as follows, with 190 lbs. steam pressure:—

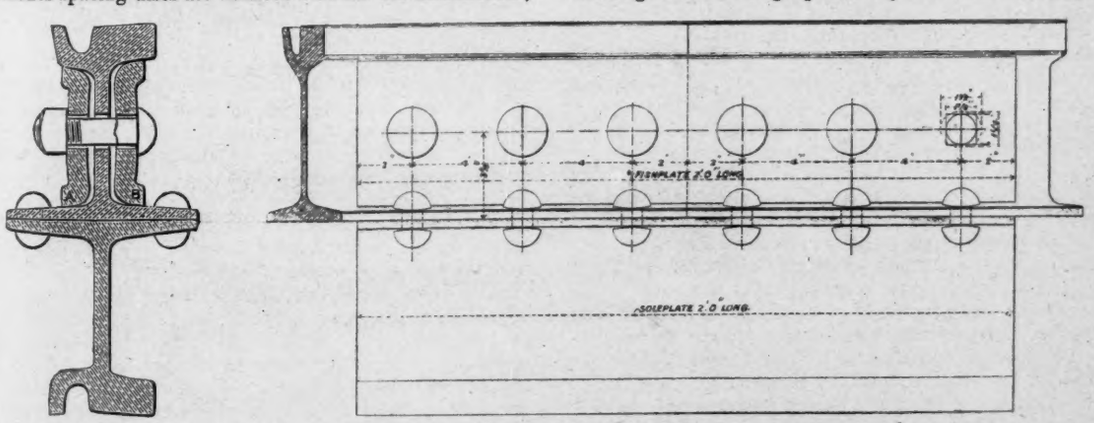
At full load, condensing,		13½ lbs.;	non-condensing,		16½ lbs.
„ ¾	„	„	13¾ „	„	16 „
„ ½	„	„	14⅛ „	„	17½ „
„ 20 % overload		„	14½ „	„	19 „

The fly-wheel, which weighs 48 tons, is bolted to the armature spider, whereby the torsional strains are transmitted directly from one to the other, instead of passing through the shaft.

The engines are controlled by an automatic governor of the relay type, an emergency governor being fitted in addition to work on the throttle valve. The expansion gear is also fitted with hand-gear for altering the cut-off, should the automatic governor fail, and the engine may be shut down instantaneously from the starting platform, by means of a knock-off lever closing the throttle.

The valve gear is of the well-known Ferranti type, in which separate steam and exhaust valves of grid form are positively driven by cams.

The switchgear has been provided by Messrs. Ferranti, Ltd., and provides for the control of the two 1,500-KW. direct-current generators, three circuits of 1,000 amperes each, and the motor circuit of a double-booster. While the gear is of the cellular type, so familiar in high-pressure alternating current stations, many modifications in detail have been introduced, rendered necessary by the use of direct currents of large power. All the switches can be opened by hand, but in addition they are controlled by automatic trip gear, those on the generators being operated by a reverse current, and those on the feeders by a maximum current. The arcing which occurs on opening the switches is taken on horn flares, mounted at the top of the switchgear.



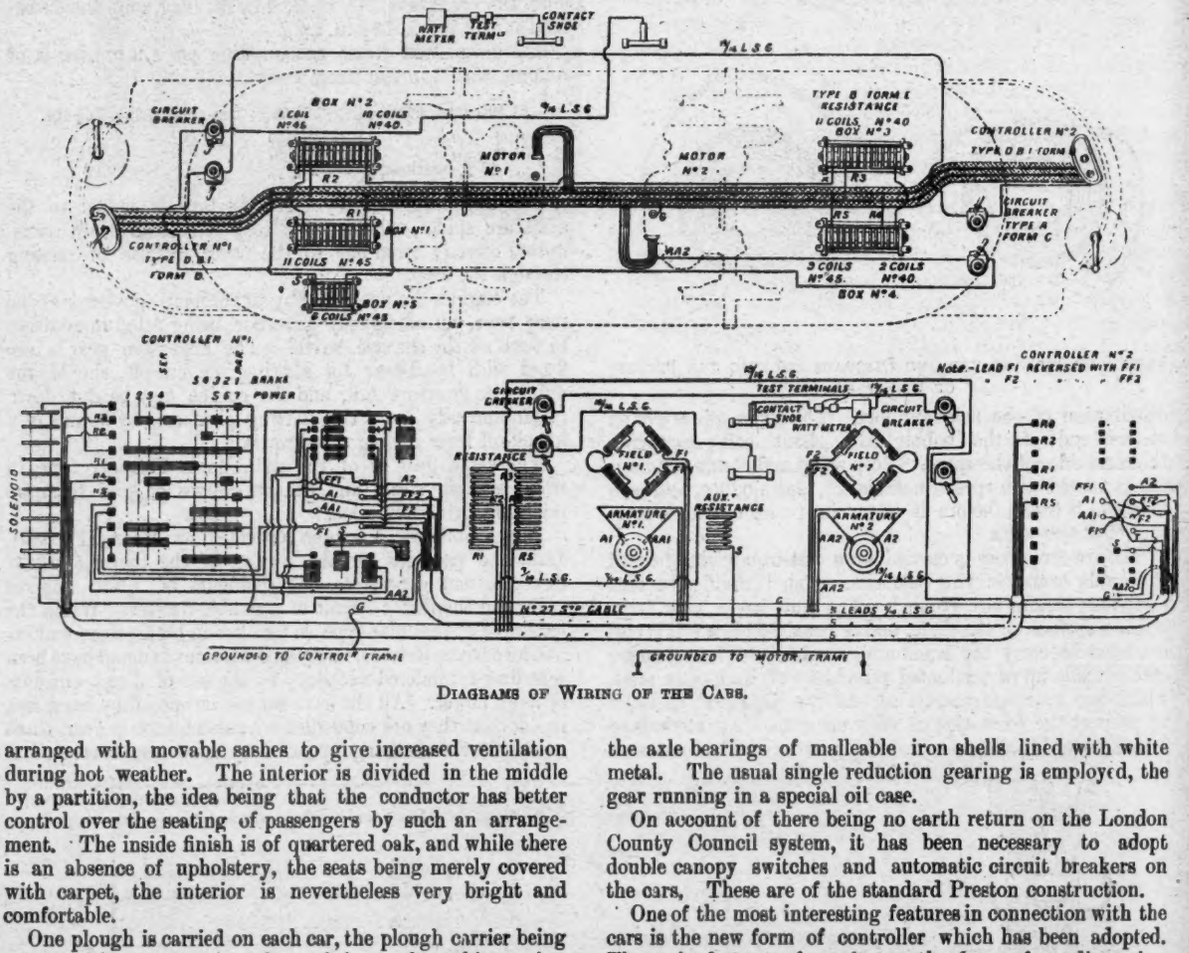
Section and Elevation of Rail at Joint.

The system will commence running with 100 cars of the

bogie type, made to the specification of Dr. Kennedy. Since this order was placed, a further order for 100 single-truck cars to the specification of Mr. J. H. Rider has been placed with Messrs. Dick, Kerr & Co., Ltd., and for 100 bogie and 100 single-truck cars with the British Westinghouse Co.

The bogie cars supplied by Messrs. Dick, Kerr and Co., Ltd., are carried on Brill maximum traction trucks, the cars themselves mainly coinciding with the standard construction adopted at the works of the Electric Railway and Tramway Carriage Co., Ltd. They are of the reversed stairway type, and are designed to carry 66 passengers each. The overall dimensions of the cars are 33 ft. 6 in. over the buffers, the extreme width being 7 ft. 1 in. The underframe of the car is constructed of teak, strengthened at the side sills by angle irons which run the whole length of the car. The structural work in the body of the car is of ash, the main body panels being of mahogany, and the remaining panels of canary white wood. The roof is of double type, the inner boarding of pine being covered with millboard.

Two large central windows and four small windows are used at each side of the car, the smaller windows being



DIAGRAMS OF WIRING OF THE CARS.

arranged with movable sashes to give increased ventilation during hot weather. The interior is divided in the middle by a partition, the idea being that the conductor has better control over the seating of passengers by such an arrangement. The inside finish is of quartered oak, and while there is an absence of upholstery, the seats being merely covered with carpet, the interior is nevertheless very bright and comfortable.

One plough is carried on each car, the plough carrier being supported by an extension of one of the trucks; this consists of a strong rectangular frame, having two channel rails on which the plough is free to move in a lateral direction.

The electrical equipment on the cars consists of two 3 A 4 type motors, which give nominally 37 B.H.P. each. This motor, while being extremely efficient, has high acceleration properties, and has been designed to meet the special conditions obtaining in London. The motors follow the standard construction adopted by Messrs. Dick, Kerr & Co., Ltd. The shell of the motor, which forms part of the field frame, is made in halves and bolted together, the front bolts forming hinges, thus enabling the lower half of the frame to be swung clear to give easy access for repairs to field coils or armatures. To the upper half of the frame the bearing supports of the axle and armature shafts are cast. Access to the brushes is obtained by means of an iron lid placed just over the commutator. The pole-pieces are built up of laminated steel, bolted to the frame; the punchings are arranged with projections which, when built up, give a special form of pole tip, designed to distribute the magnetic field in such a way as to produce sparkless commutation, while also serving to hold the field coils in position. The field coils are machine wound upon a former of the same shape as the pole-pieces, over which they are to be fitted. After being removed from the former they are immersed in an insulating compound, which fills the spaces between the wires. The complete coil is waterproofed with a compound which renders it impervious to moisture, and the magnet coil is secured in the motor frame by means of a rectangular bronze frame, which is forced into the interior of the coil. The armature core is built up of discs punched from sheet steel of high quality, securely keyed on the shaft, and ground to perfect cylinders. The armature coils are all alike and interchangeable, and special care is taken in their manufacture. The commutator is carried on a cast-iron hub accurately bored to fit the armature shaft, a special micanite insulating ring being inserted between the bars and the hub. The finished commutator is tested with a high alternating pressure between the segments. The armature bearings are of bronze, and the axle bearings of malleable iron shells lined with white metal. The usual single reduction gearing is employed, the gear running in a special oil case.

On account of there being no earth return on the London County Council system, it has been necessary to adopt double canopy switches and automatic circuit breakers on the cars. These are of the standard Preston construction.

One of the most interesting features in connection with the cars is the new form of controller which has been adopted. The main features of novelty are the form of arc-disrupting device, and the arrangements for rheostatic braking. The arc-disrupting device consists of a solid iron core extending from the top to the bottom of the controller. This core is suitably wound throughout its entire length, but the windings are not all in the same direction; they are so arranged that the magnetic flux shall have proper relation to the direction of current flowing in the arc. Where a change in the direction of the winding becomes necessary, a flange is cast on the core. The windings are then covered with suitable insulation, around which is placed a series of thin copper rings, so arranged that each ring subtends a finger and contact. The blow-out windings are in series with the main current, and the effect upon an arc created between a finger and contact is that the arc becomes so attenuated that disruption takes place, as shown in the diagrams on page 837, the whole process

being completed almost instantaneously. The contacts are entirely saved from damage, and the nature of the arc under the influence of the blow-out is comparatively innocuous; any deterioration of the copper rings after several months of operation under severe conditions is quite inappreciable. The whole blow-out device is placed so that the copper rings are in close proximity to the source of the arcs, but for convenience it is mounted on pivotal hinges, so that it may be swung back for inspection of the fingers, &c., or lifted right away from the controller, if required, without unscrewing any nuts or bolts whatever. The electrical connections for the blow-out windings are made automatically when the blow-out is in position. The blow-out is short-circuited when on either the full series or parallel notches, but comes again into operation prior to any break in the circuit being made, on the movement of the controlling handle.

In connection with the rheostatic braking, it has always been a difficulty, when providing sufficient power notches for easy acceleration, to arrange for a sufficient number of brake notches, without reducing to an inconvenient minimum the distance between two notches. Messrs. Dick, Kerr & Co., however, entirely overcame this trouble by arranging that the three notches used for power working in parallel should also do duty for the braking when approached in the opposite direction, *i.e.*, from the brake side. In addition, two further brake notches are provided, which on the power side are merely transition notches. The controller under consideration has seven power and five brake notches, and the spacing between them is liberal; this, together with a positive and easy action of the notching gear, renders it almost impossible for the most careless of motormen to rest between the proper notches.

The driving handle is provided with a milled-head screw clamp to take up wear. The controller cover is easily removable by means of a catch situated near the foot of the controller, a great convenience with the present style of car construction. The power cylinder is of substantial construction, and is divided into three sections, insulated from each other and from the central spindle. The top section consists of seven rows of contacts, engaging with seven fingers; these control the resistance in circuit and the operation of the blow-out. The next section of three contacts and fingers controls, in conjunction with the bottom section of one contact and finger, the connections of the motors for series or parallel running. Either motor may be cut out, and the car run on the remaining one.

The diagrams on the opposite page give a clear idea of the wiring arrangements in connection with this form of controller. Some alteration from the standard wiring is necessitated by the completely insulated return.

As we have already stated, the chief contractors in connection with the Tooting section were Messrs. J. G. White and Co., Ltd., for the road work; Messrs. Dick, Kerr & Co., Ltd., for the generating plant and cars, with engines by Messrs. Ferranti, Ltd.; and the British Insulated and Helsby Cables, Ltd., for low pressure cables. Messrs. W. Scott, Ltd., supplied the rails, and the Lorain Steel Co. the special work, while the switchgear was supplied by Messrs. Cowans, Ltd., and Messrs. Ferranti, Ltd. We are indebted to several of these firms for kind assistance in the preparation of this article.

The consulting engineer to the Council was Dr. Kennedy. Mr. Alfred Baker is the general manager of the tramways, and Mr. J. H. Rider the electrical engineer. The buildings were designed by Mr. W. E. Riley, architect to the Council, and have been erected in great part by the Council's staff, under the works manager, Mr. Humphreys, while the electrical work in connection with the temporary power station and the sub-stations, and the laying of the mains, has been carried out by Mr. Rider.

NOTES.

(*Continued from page* 826.)

The late Dr. Hopkinson.—In the large lecture room of the Engineering Laboratory at Cambridge on Monday, Sir Joseph Lawrence, M.P., unveiled a bust of the late Dr. John Hopkinson. The bust was presented to the laboratory by the directors of the Linotype Co. After the ceremony, Lord Kelvin said he was sure Prof. Ewing would remember with gratitude what John Hopkinson did in the way of bringing into existence the Engineering School of the University of Cambridge. Hopkinson was an undergraduate in the University at a time when it gave little encouragement to anyone who desired to cultivate physical sciences; but it gave great advantages to all in the strong foundation that it laid in mathematical training. The old-fashioned Senior Wrangler of Cambridge would for ever remain an honoured name and a coveted title. The Engineering School, which had now developed so magnificently under Prof. Ewing, with the hearty co-operation of the old members of the University, owed its existence in its present form very much, indeed, to Hopkinson. For months and years before his death he was engaged in planning for the great development which they now had, and his good work had borne fruit after his death. The Vice-Chancellor, referring to the impending departure of Prof. Ewing, to take up his duties of Chief Naval Instructor, said that the nation was greater even than the University of Cambridge, and he did not doubt that Prof. Ewing did right not to hesitate for a moment when the larger call came.

London County Council.—The Council decided at the meeting on Tuesday, to lend £1,535 to the Stepney B.C., and £1,413 to the Poplar B.C., for electric lighting purposes.

The Highways Committee submitted a joint report by the chief engineer and the tramways manager, dealing with the relative cost of the conduit and overhead trolley systems of electric traction. The report shows that the total cost of the roadwork and platelaying for the reconstruction of the Tooting lines, including the diversion of pipes, has amounted to approximately £224,020, which divided by the length (16·4 miles), gives a cost of £13,600 per mile of single track. It is estimated that the expenditure on the Greenwich lines will reach £14,041 per mile, and as compared with the overhead trolley system, the cost of the conduit is shown to be 33·13 per cent. higher.

The Royal Society.—Among papers down for reading yesterday afternoon were the following:—

"The Combination of Hydrogen and Chlorine under the Influence of Light," by P. V. Bevan. Communicated by Prof. J. J. Thomson, F.R.S.

"On the Photo-Electric Discharge from Metallic Surfaces in Different Gases," by Dr. W. Mansergh Varley. Communicated by Prof. J. J. Thomson, F.R.S.

"On the Radiation of Helium and Mercury in a Magnetic Field," by Prof. A. Gray, F.R.S, and Dr. W. Stewart; with R. A. Houston and D. B. McQuistan.

Lecture on Motor-cars.—Mr. O'Gorman's lecture on Friday last, May 8th, at Caxton Hall, was excellent in manner. It seems ridiculous that it should cost more to send goods by rail than by road. Yet the lecturer assured us, if we heard aright, that by rail the cost was 4d. per ton-mile as against 1d. by tractor on the roads. We receive postal packages on which we find the stamp "Road borne," whence we infer that it pays the Post Office to bring parcels from such places as Ipswich by road, and not by rail. The lecturer pointed out the importance of motor vehicles to us, a —he might have said the—colonising nation. He adjured us to buy land, and one of the many half-timbered lovelinesses to be had for an old song, because out of reach. The country is going up in price. The old inns are to become valuable, and will afford meat and drink for man and beast—we mean motor—as of yore. The lecturer told us of an aged aunt who abjured motor-cars as machinations of evil, and walked three out of seven miles to her home alongside her nephew's car. Finally she consented to ride, but at her walking pace. The jeers of rusticity induced a plaintive request to go a wee bit faster, and the rapidly approaching dinner hour—possibly the fear of her own cook's wrath—finally decided the affair on a basis of speed. Aunty now owns three cars. Need more be said? As to cost of cars, while it may cost £300 to buy a car to do five miles an hour up hill, a maximum of 26 and an average of 15 miles per hour, it will cost £1,000 to change these figures to 16, 26 and 40, and about £50 for each mile per hour added to the slower car may be counted on as the price of speed. Mr. O'Gorman did not forget to tell us of the troubles of motor-cars, which were detailed with sufficient emphasis; he showed various photographs of interest, and an excellent series of animatograph pictures taken from a balloon, as well as a motor-balloon with a cleverly sophisticated collapse of the same. Risks were dealt with, and the kind considerateness of the motorist was placed in a favourable light, which hardly seemed to fit one's personal experience of the fiends on the Brighton road. Motoring seems to render men callously indifferent to the rights and comforts of others, and brings out the most selfish of traits, as cyclists, pedestrians, horse-drivers, and all will agree. Of course this is not the view held by the man in the car, who experiences a keen pleasure in tooting suddenly and loudly where he might toot gently and ascendingly. Nor does he consider the restive horse, or soothe it by the infallible remedy of speaking to it from the car. But we are sure Mr. O'Gorman fails not, and we hope to hear him lecture again.

The International Telegraph Conference: Electro-Harmonic Concert.—Mr. W. E. Lane, the hon. secretary, asks us to announce that the Electro-Harmonic Society has decided to give a Special Extra Concert (Ladies' Night) on Friday evening, June 5th next, in honour of the Foreign Delegates to the forthcoming International Telegraph Conference in London. The concert will be held in the King's Hall, Holborn Restaurant, and Sir William H. Preece, K.C.B., F.R.S., has kindly consented to occupy the chair.

Memorial to Sir Henry Bessemer.—A representative Committee, with Sir William Preece chairman Mr. Julius Wernher as a trustee, has been formed for the purpose of raising a memorial to the late Sir Henry Bessemer. The objects of the memorial are:—(1) The erection (and, if necessary, the endowment) of metallurgical teaching and research works in connection with the University of London, equipped for the testing of ores and metallurgical products by modern methods and for the investigation of new methods and processes; and (2) the foundation of international scholarships for post-graduate courses in practical work in connection with proposals now under the consideration of the Board of Education. The Committee includes leading representatives of the metallurgical, engineering and mining industries and professions, and of education authorities. A meeting to inaugurate the fund will be held at the Mansion House on Monday, 29th prox. All communications should be addressed to the secretary, Bessemer Memorial Fund, Salisbury House, E.C.

Preparation of Alkali Metals by Means of Calcium Carbide.—A German patent has been taken out by a firm in Frankfurt-am-Main for a process of winning alkali metals with the aid of calcium carbide. A simple fluoride, a double fluoride, or a silico-fluoride of the desired alkali metal is heated in a suitable vessel to a red heat in presence of calcium carbide, when a double decomposition is stated to occur, yielding the carbide of the alkali metal and a simple or double fluoride of calcium. On pushing the temperature a little higher, the alkali carbide breaks up, and the liberated metal can be distilled over in the usual way. Moreover, it is claimed that if nitrogen or ammonia gas is led over the product of the reaction in order to prevent oxidation, a part of the carbide is converted into a cyanide by attraction of the nitrogen; and this cyanide can be recovered by lixiviating the residue. The whole process is claimed to be specially suited to the preparation of potassium, which, by its aid, can be won at a price that will render the metal a useful chemical re-agent; while it also forms an additional use for calcium carbide.

Far from the Madding Crowd!—In the form of a charmingly-illustrated and attractively-written booklet, a guide to the Metropolitan Railway Extension in Middlesex, Hertfordshire and Buckinghamshire has just been issued, with a list of country apartments to be let in the vicinity of the company's stations. How few people have more than a vague notion that the Metropolitan Railway is not restricted to the London area, and yet the extension of this line for a distance of over 50 miles passes through the above-mentioned counties, and in its course traverses a section of the country containing scenery of the most picturesque and varying description. Step by step the Metropolitan Railway has opened up districts where the traveller and pleasure-seeker may find unlimited scope for the gratification of every variety of taste, and where the tired Londoner, in search of some spot which will ensure his well-earned rest being enjoyed undisturbed, will find a welcome respite from the glamour and whirl of City life and the endless monotonies of business. A chapter of more than passing interest entitled "Electric Traction on the Metropolitan Railway" brings the booklet to a fitting conclusion, as showing that nothing is being left undone in the way of quick transit, combined with cheap fares, to make the line popular with all classes of the community. Every information as to trains, fares, &c., will be gladly furnished by the general manager, Mr. A. C. Ellis, at 32, Westbourne Terrace, London, W., who is to be congratulated on the publication of such a fascinating and delightfully fresh little brochure.

Engineering Education.—One part of the annual report of the Technical Education Board of the London County Council deals with the engineering and metal trades. There are now classes in machine construction and drawing at 22 centres, and general courses in engineering at 14 centres. Mechanics, theoretical and applied, is dealt with at 19 centres and steam at 12 centres. In the polytechnics alone it is estimated that 2,500 young engineers are attending classes in these trades; and engineering students also study mathematics, mechanics, physics, chemistry and other branches of science. An important development in the Battersea Polytechnic is technical instruction in the industries connected with electric traction; and the most important feature in the engineering and metal trades during the past session has been the great demand for classes in electrical engineering generally.

Leicester's Loyalty.—It will be remembered by readers of the ELECTRICAL REVIEW that when the call for help came from South Africa, the electrical and gas departments of the Leicester Corporation came very enthusiastically to the assistance of the country. No fewer than 78 men "donned the uniform of the Queen, either as reservists or volunteers." "59 went out to the war," and did important service in the campaign, and "19 were kept at home to do garrison duty." It is a remarkable result that in spite of the hard fighting and hardships to which the men were subjected, every one of them returned safely. Those who remained at home cared for the wives and families of those who were away. We cannot spare room to tell the story of the most excellent service which was rendered on the field of battle, and the financial aid which was made available at Leicester; if any of our readers take a special interest in the department, perhaps Lieut. D. F. Colson, the manager and engineer of the department, who himself was engaged in active service, *may* be able to spare them a copy of a very interesting 30-page booklet, which has been issued, telling of the doings of "The Leicester Gas and Electric Lighting Undertaking and its Soldiers."

Blue Print Production and Special Arc Lamps.—M. Jacquin, in a recent issue of *L'Eclairage Electrique*, gives particulars of experiments he has made with a Broca arc lamp in connection with the production of blue and sun prints. The feature of the lamp in question is the use of carbons having a core of carbide of iron. The lamp in question was a hand-regulated one, placed on a 110-volt circuit, with a rheostat interpolated. The positive carbon, which forms small globules of iron, was, contrary to the usual method, placed below. The arc was fairly long, and regulated to take about 18 amperes at a difference of potential of from 30 to 35 volts. Behind the carbons was placed a vertical bent sheet of zinc, forming a reflector, and sending the rays on to a frame measuring 24 × 30 centimetres, and supported in a vertical position at a distance of 20 centimetres. Experiments were afterwards made with ordinary carbons of equal dimensions, with the same paper, the same intensity of current and the same distances. A fairly long arc was employed, corresponding to 48 volts, in order to give rise to violet rays. As a result of the tests it was found that the production of blue-prints, white drawings on blue with ferro-prussiate paper, or black drawings on a white ground on heliographic paper, could be done *three times more rapidly* with the carbide of iron arc than with the ordinary arc. M. Jacquin adds that the experiments he made have only a theoretical interest, inasmuch as they were made with a hand-regulated lamp. To be of practical use, the lamps would have to be provided with an automatic regulating device, which will require carefully thinking out, owing to the fact that the fusion of the carbide core tends to cause the carbons to stick together, after which it is difficult to get them apart. He concludes by recommending manufacturers of arc lamps to inquire into the matter of the production of a robust lamp with carbons having cores of carbide of iron, and to make comparative trials for themselves of such lamps with ordinary arc lamps and with those having closed globes.

The Curtis Steam Turbine.—This is another of those turbines of multiple effect by which the enormous velocity of flow of steam is reduced by passing it through a series of blades, none of which move at a velocity more than a fraction of the speed of the steam. Practically, such turbines consist of so many De Laval wheels separated by rings of fixed blades. Tests are said to have shown that, with steam at 140 lbs., a 600-KW. dynamo consumed 19·5 lbs. of steam per kilowatt-hour, when the vacuum was 28·5 in., the output being 475 KW., and the steam saturated. At 600-KW. output the steam consumption was 19·2, and at 775 KW. it was 19·1, showing a considerable range for economical operation. With 150° F. superheat, great economy was realised, the steam consumption being 17 lbs. at 450 KW., 16·75 at 600 KW., and 16·7 at 775 KW. A 5,000-KW. set is to be put to work shortly, and contracts are said to be in hand for many thousands of horse-power. Governing is effected by closing some of the steam nozzles, as is done, for example, in the Girard water turbine. The steam turbine appears to be making headway in America, which has followed British practice consistently after a few years' delay. Direct driving, which took hold so very slowly, will be a necessity with turbine work. Every steam turbine appears to differ very little from any other. They are all so many arrangements of curved vanes—in fact, so many steam Pelton wheels.

Personal.—Mr. A. Stewart, who is relinquishing the post of traffic manager for the Dudley and Stourbridge District Electric Traction Co. for an appointment with the City of Birmingham Tramway Co., has been presented by the employés of the former company with a gold Albert and seal, silver matchbox, pouch and case of pipes.

The Electricity in Mines Committee.—We read in the *Times* that the Home Secretary has appointed Mr. W. H. Patchell, member of the Council of the Institution of Electrical Engineers, to be a member of the Committee to inquire into the use of electricity in mines, in the place of Mr. James Swinburne, resigned.

For Sale.—Tenders are being invited for the goodwill, trade marks, &c., of H. M. Salmony & Co. (in liquidation). See our advertisement pages to-day.

British Electric Street Tramways.—The petition of Mr. A. J. Paine for winding up this company was first in the list of Mr. Justice Byrne's Court on Tuesday, but owing to its lengthy character, his Lordship directed the petition to stand over for a fortnight.

Annual Dinner.—The annual dinner of the electrical engineering departments of the Willesden and Tottenham Polytechnics (Middlesex County Council), was held at the Holborn Restaurant on Friday evening last, under the chairmanship of Mr. Frederic H. Taylor, who, in replying to a toast, referred to the excellent work which was being done by the engineering society connected with the Polytechnics, and to the educational value it undoubtedly possessed. The other toasts and speeches were interspersed with a programme of songs and sketches, arranged by Mr. Wm. Short.

Lectures.—Mr. J. T. Morris's course of lectures on "Three-phase Work" and "Electric Lighting" are to commence on Monday and Wednesday respectively next week, at the East London Technical College.

THE CENTRAL STATION ENGINEER.

The Reading Town Council has appointed Mr. Walter Binns, of Newcastle Corporation Tramways Department, to the position of tramways engineer, at a salary of £300 per annum. On Friday, May 1st, Mr. A. E. Le Rossignol, on behalf of the staff of the Newcastle Corporation power station, presented Mr. Binns with a silver rose bowl on an ebony plinth, and also a pair of silver flower vases, as a mark of esteem on the occasion of his leaving for Reading.

Mr. J. Arthur Sykes, who has left the Rhyl electrical works to fulfil an appointment at the Mansfield electrical works, was presented by the staff with a silver-mounted walking stick, suitably engraved.

Mr. J. C. Vaudrey has intimated his intention to resign the post of electrical engineer to Birmingham T.C. at the end of 1904, the term at which his agreement expires, but he asks to be relieved of his duties after July next. The Electric Supply Committee recommends that Mr. Vaudrey should be retained as consulting electrical engineer for a year at a fee of 500 guineas.

Salford T.C. on May 6th appointed Mr. James Scott Pringle as assistant electrical engineer, at £250 per annum (rising by £50 per year to £400.) Mr. A. C. Wright was also appointed engineer-in-charge.

The staff of the Middlesbrough Corporation Electricity Works held their first annual dinner on Wednesday, May 6th. The borough electrical engineer, Mr. Taylor, took the chair, and a most enjoyable evening was spent. It was followed by the usual "Smoker," and the success of the evening guaranteed it being continued annually.

Out of over 100 applicants, Mr. John Senior, assistant electrical engineer to Huddersfield Corporation, has secured the post of resident electrical engineer at Mexborough.

On Monday, 4th inst., at the electricity works, Leytonstone, Mr. T. W. Merry, who has resigned the position of charge engineer to take up a similar one at the King's Road Station of the St. Pancras Borough Electricity Department, was the recipient of a calculator and a case of pipes, presented to him by his old colleagues. The presentation was made by Mr. F. Harman Lewis, the engineer and manager, who paid a very warm tribute to Mr. Merry's ability and industry and wished him every success.

Mr. Stockbridge, junior assistant of the Bury electricity works, has taken up a position under the Westinghouse Co. at Trafford Park.

NEW COMPANIES REGISTERED.

Codd Arc Lamp Co., Ltd. (77,217).—This company was registered on April 29th, with a capital of £2,000 in £1 shares, to acquire the business and property of L. B. Codd (trading as the "Codd Arc Lamp Co.," at Nottingham), and to carry on the business of manufacturers of, and dealers in, arc lamps and accessories, the inventions of the said L. B. Codd, iron and brass founders, electricians, engineers, tool and implement makers, manufacturers of, and dealers in, gas, oil and electric motors, manufacturers of electrolytic apparatus, &c. The first subscribers (each with one share) are:—A. R. M. Simkins, 10, North Avenue, West Ealing, W., electrical engineer; L. B. Codd, Standard Works, Dame Agnes Street, Nottingham, electrical engineer; E. L. Thorpe, Standard Works, Dame Agnes Street, Nottingham, engineer; W. Robinson, 34, The Close, Nottingham, hosiery manufacturer; J. H. Scott, 13, Amburgh Road, Nottingham, machine builder; F. Roebuck, 16, High Road, Beeston, machine turner; and W. H. Facon, Nottingham, solicitor. No initial public issue. The number of directors is not to be less than two nor more than seven; L. B. Codd and A. R. M. Simkins are the first managing directors; remuneration as fixed by the company or by the board; qualification of subsequent directors, 150 shares. Registered office, Standard Works, Dame Agnes Street, Nottingham.

Lancashire Power Construction Co., Ltd. (77,202).—This company was registered on April 29th, with a capital of £300,000 in £1 shares (18,000 "A" and 12,000 "B"), to adopt an agreement with the Lancashire Electric Power Co., to sub-contract with the Edmundson's Electricity Corporation, Ltd., upon the terms mentioned in a provisional contract, dated April 28th, 1902, and to carry on the business of contractors for the construction, equipment and maintenance of generating stations and works for generating, storing, regulating, transmitting and supplying electrical energy for motive power, locomotion, lighting, heating, telegraphic or telephonic purposes, tramway and light railway constructors, electricians, mechanical engineers, accumulators and distributors of electricity, &c. The first subscribers (each with 50 shares) are:—F. E. Gripper, Broad Sanctuary Chambers, Westminster, engineer; W. B. Hopkins, Club House, Surrey Street, W.C., engineer; T. O. Callender, Hamilton House, Victoria Embankment, E.C., engineer; E. A. Carolan, 88, Cannon Street, E.C., engineer; W. R. Davis, 10, Moorgate Street, E.C., stockbroker; M. Barr, Temple Barr House, E.C., engineer; and N. Kennedy, 37, Walbrook, E.C., engineer. The number of directors is not to be less than three nor more than seven; the first are M. Barr, T. O. Callender, E. A. Carolan, F. E. Gripper, W. B. Hopkins and N. Kennedy; qualification, 50 shares; remuneration, £200 each per annum.

J. Bakewell & Co., Ltd. (77,192).—This company was registered on April 28th, with a capital of £15,000 in £1 shares (9,000 preference), to acquire the business of electrical and general engineers and ironmongers now carried on at 46, King William Street, E.C., and at Peterborough and Southend-on-Sea, as J. Bakewell & Co., to adopt an agreement with J. Bakewell and E. Bakewell, and to carry on the business of electrical engineers, manufacturers and constructors of cables, wires, lines, accumulators, lamps and works, electricians, suppliers of electricity, &c. The first subscribers are:—W. Bakewell, Volt Works, Attercliffe, Sheffield, electrical engineer, with 500 shares; J. W. Farnsworth, Volt Works, Attercliffe, Sheffield, manager, with 100 shares; E. Bakewell, 50, Narrow Street, Peterborough, electrical engineer, with 10 shares; J. Bakewell, 46, King William Street, E.C., electrical engineer, with 10 shares; J. H. Holme, 46, King William Street, E.C., accountant, with one share; W. H. J. Gore, 95, Windsor Road, Ilford, book-keeper, with one share; and H. H. Jones, 46, King William Street, E.C., electrician, with one share. Minimum cash subscription, 2,000 shares. The number of directors is not to be less than three nor more than seven. The first are J. Bakewell and E. Bakewell (managing directors), W. Bakewell and J. W. Farnsworth; qualification (except first managing directors), 100 shares; remuneration, £15 each per annum. Registered office, 46, King William Street, E.C.

Miller Signal Syndicate for India, Ltd. (77,174).—This company was registered on April 27th, with a capital of £2,500 in £1 shares, to acquire from A. S. Morrison the benefit of an agreement with G. Failing, of Mendota, U.S.A., on behalf of himself and W. H. Clinton, of Chicago, arising out of certain negotiations for the acquisition of certain patent rights, to adopt a proposed agreement with A. S. Morrison, G. Failing and H. C. Cooke, to acquire and turn to account the patents owned or controlled by the said G. Failing and W. H. Clinton for India, and to carry on the business of railway and other signal makers and installers according to the "Miller" system, electricians, engineers, suppliers of electricity, &c. The first subscribers are:—A. S. Morrison, The Lodge, Pinner, merchant, 100 shares: A. H. Morrison, 4, Leinster Gardens, W., gentleman, 100 shares; E. H. Jackson, 154, Leadenhall Street, E.C., advertising agent, 50 shares; J. E. Baxter, Oakfield, Farrington, Lancs., india-rubber manufacturer, 100 shares; R. Fegan, Westcombe Park, Blackheath, S.E., M.D., 50 shares; E. B. Morrison, 23, Greencroft Gardens, Hampstead, N.W., gentleman, 25 shares; and W. E. Reilly, Thorner's Chambers, Fenchurch Street, E.C., surgeon, 50 shares. No initial public issue. Registered without articles of association.

World's New Accumulator Co., Ltd. (77,227).—This company was registered on April 30th, with a capital of £7,500 in 1s. shares, to carry on the business of manufacturers of electrical accumulators, cycles, bicycles, tricycles, motor-cars, velocipedes, perambulators and carriages of every description, mechanical engineers, electricians, machinists, fitters, millwrights, founders, tube makers, saddlers, &c. The first subscribers (each with one share) are:—Cte. R. de F. Maunder, 1, Comeragh Road, West Kensington; Cte. de F. Maunder, 1, Comeragh Road, West Kensington; S. Schanschieff, 5, Stile Hall Mansions, Chiswick, W., engineer; G. Neville, Winchester House, E.C., solicitor; H. E. J. Williams, 81, Winchester House, articled clerk; E. R. Maunder, 80, Winchester House, E.C., clerk: and F. W. Merriman, Winchester House, E.C, solicitor. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; remuneration, £150 each per annum (£50 extra for the chairman), and 5 per cent. of the distributed profits after 5 per cent. dividend has been paid, divisible.

Kreiger Electric Carriage Syndicate, Ltd. (77,194).—This company was registered on April 28th, with a capital of £30,000 in £10 shares, to carry on the business of manufacturers of and dealers in motor-cars, motor-tractors, motor-vans, motor-cycles, velocipedes and carriages of all kinds, electrical, mechanical and general engineers, machinists, fitters, millwrights, founders, &c. The first subscribers (each with one share) are:—P. W. Northey, Ashtead Park, Surrey, electrical engineer; A. L. Shepherd, 8, West Kensington Gardens, W., electrical engineer; R. Paling, The Lodge, Effingham, Surrey, gentleman; C. W. Potter, 89, Sarfield Road, Balham, S.W., secretary; D. Buchan, 69, Fielding Road, Bedford Park, W., private secretary; W. H. Cooker, 45, Lupus Street, Belgravia, S.W., clerk; and H. G. Bach, St. Heliers, Sheepcote Road, Harrow, accountant. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first.

Craigpark Electric Cable Co., Ltd. (5,333).—This company was registered in Edinburgh on May 1st, with a capital of £150,000 in £1 shares, to carry on the businesses of manufacturers, buyers, sellers and dealers in cables (electric, insulating or otherwise), and all gutta-percha and rubber goods, whether for cables or otherwise, and all other works connected with telegraphic, telephonic and electric enterprises, manufacturers of cycles, or tires, golf, football or other balls, &c. The first subscribers (each with 250 shares) are:—J. T. Tullis, John Street, Bridgeton, Glasgow, merchant; W. S. Brown, Viewfield, Giffnock, merchant; W. B. Dick, 13, Exchange Place, Glasgow, merchant; C. Hamilton, 247, St. Vincent Street, Glasgow, electrical engineer; A. R. Maclean, Flemington Street, Springburn, Glasgow, managing director; J. Kellock, 26, Renfield Street, Glasgow, chartered accountant; and J. Deas, 1, Blythswood Drive, Glasgow, secretary. The number of directors is not to be less than three nor more than seven; the first are J. T. Tullis, W. S. Brown, W. R. Dick, C. Hamilton and A. Maclean; qualification, 250 shares; remuneration, £550 per annum, divisible. Registered office, Flemington Street, Springburn, Glasgow.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Woking Electric Supply Co., Ltd. (46,175).—Issue, on April 7th, of £800 debentures, and on April 18th of £300 debentures, part of a series created November 2nd, 1902, to secure £25,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Total amount previously issued of same series: £19,120.

Gravesend and Northfleet Electric Tramways, Ltd. (69,877).—A trust deed dated April 23rd, 1903, to secure £40,000 debenture stock (with power to make further issues up to half the issued capital) has been registered. Property charged: The company's assets, present and future. Trustees: Electric and General Investment Co., Ltd., 1—2, Great Winchester Street, E.C.

Eastern Telegraph Co., Ltd. (6,338).—£775 debenture stock created and dated April 22nd, 1903, as a first charge on the company's undertaking and revenue has been registered. Holder: F. R. de Livanté, 141, Hill Street, Peckham, S.E.

Minehead Electric Supply Co., Ltd. (74,382).—A debenture for £700, dated April 24th, 1903, charged on the company's undertaking and property, present and future, including uncalled capital, and a mortgage of even date, for the same amount (as collateral security), charged on land, engine house, store room, &c., at Minehead, have been registered. Holders: J. R. Paramore, Minehead, and the Rev. J. R. Paramore, jun., Iddesleigh Rectory, Devon.

J. E. H. Andrews & Co., Ltd. (Gas and Electrical Engineers, Stockport).—Issue, on April 29th, of £12,500 debentures, part of a series created October 27th, 1902, to secure £40,000, charged on freehold land at Reddish, Stockport, and to company's other assets, present and future, including uncalled capital. Trustees: W. Hobson, Suffolk Works, Sheffield; H. L. Faber, Lomond, South Hill Park, Bromley; and G. Johnson, Randall's Steam Joinery Works, Sheffield. Total amount previously issued of same series: £13,300.

ELECTRICITY SUPPLY ACCOUNTS.

Bristol Corporation Electricity Supply.

The returns of the Bristol Electrical Department show a noteworthy improvement over the two years preceding.

A reduction in working expenses and a great increase in output, particularly for power purposes, have served to earn a greatly increased profit over the previous year.

The progress of the undertaking will be gathered from the following figures:—

Memorial to Sir Henry Bessemer.—A representative Committee, with Sir William Preece chairman Mr. Julius Wernher as a trustee, has been formed for the purpose of raising a memorial to the late Sir Henry Bessemer. The objects of the memorial are:—(1) The erection (and, if necessary, the endowment) of metallurgical teaching and research works in connection with the University of London, equipped for the testing of ores and metallurgical products by modern methods and for the investigation of new methods and processes; and (2) the foundation of international scholarships for post-graduate courses in practical work in connection with proposals now under the consideration of the Board of Education. The Committee includes leading representatives of the metallurgical, engineering and mining industries and professions, and of education authorities. A meeting to inaugurate the fund will be held at the Mansion House on Monday, 29th prox. All communications should be addressed to the secretary, Bessemer Memorial Fund, Salisbury House, E.C.

Preparation of Alkali Metals by Means of Calcium Carbide.—A German patent has been taken out by a firm in Frankfurt-am-Main for a process of winning alkali metals with the aid of calcium carbide. A simple fluoride, a double fluoride, or a silico-fluoride of the desired alkali metal is heated in a suitable vessel to a red heat in presence of calcium carbide, when a double decomposition is stated to occur, yielding the carbide of the alkali metal and a simple or double fluoride of calcium. On pushing the temperature a little higher, the alkali carbide breaks up, and the liberated metal can be distilled over in the usual way. Moreover, it is claimed that if nitrogen or ammonia gas is led over the product of the reaction in order to prevent oxidation, a part of the carbide is converted into a cyanide by attraction of the nitrogen; and this cyanide can be recovered by lixiviating the residue. The whole process is claimed to be specially suited to the preparation of potassium, which, by its aid, can be won at a price that will render the metal a useful chemical re-agent; while it also forms an additional use for calcium carbide.

Far from the Madding Crowd!—In the form of a charmingly-illustrated and attractively-written booklet, a guide to the Metropolitan Railway Extension in Middlesex, Hertfordshire and Buckinghamshire has just been issued, with a list of country apartments to be let in the vicinity of the company's stations. How few people have more than a vague notion that the Metropolitan Railway is not restricted to the London area, and yet the extension of this line for a distance of over 50 miles passes through the above-mentioned counties, and in its course traverses a section of the country containing scenery of the most picturesque and varying description. Step by step the Metropolitan Railway has opened up districts where the traveller and pleasure-seeker may find unlimited scope for the gratification of every variety of taste, and where the tired Londoner, in search of some spot which will ensure his well-earned rest being enjoyed undisturbed, will find a welcome respite from the glamour and whirl of City life and the endless monotonies of business. A chapter of more than passing interest entitled "Electric Traction on the Metropolitan Railway" brings the booklet to a fitting conclusion, as showing that nothing is being left undone in the way of quick transit, combined with cheap fares, to make the line popular with all classes of the community. Every information as to trains, fares, &c., will be gladly furnished by the general manager, Mr. A. C. Ellis, at 32, Westbourne Terrace, London, W., who is to be congratulated on the publication of such a fascinating and delightfully fresh little brochure.

Engineering Education.—One part of the annual report of the Technical Education Board of the London County Council deals with the engineering and metal trades. There are now classes in machine construction and drawing at 22 centres, and general courses in engineering at 14 centres. Mechanics, theoretical and applied, is dealt with at 19 centres and steam at 12 centres. In the polytechnics alone it is estimated that 2,500 young engineers are attending classes in these trades; and engineering students also study mathematics, mechanics, physics, chemistry and other branches of science. An important development in the Battersea Polytechnic is technical instruction in the industries connected with electric traction; and the most important feature in the engineering and metal trades during the past session has been the great demand for classes in electrical engineering generally.

Leicester's Loyalty.—It will be remembered by readers of the Electrical Review that when the call for help came from South Africa, the electrical and gas departments of the Leicester Corporation came very enthusiastically to the assistance of the country. No fewer than 78 men "donned the uniform of the Queen, either as reservists or volunteers." "59 went out to the war," and did important service in the campaign, and "19 were kept at home to do garrison duty." It is a remarkable result that in spite of the hard fighting and hardships to which the men were subjected, every one of them returned safely. Those who remained at home cared for the wives and families of those who were away. We cannot spare room to tell the story of the most excellent service which was rendered on the field of battle, and the financial aid which was made available at Leicester; if any of our readers take a special interest in the department, perhaps Lieut. D. F. Colson, the manager and engineer of the department, who himself was engaged in active service, may be able to spare them a copy of a very interesting 30-page booklet, which has been issued, telling of the doings of "The Leicester Gas and Electric Lighting Undertaking and its Soldiers."

Blue Print Production and Special Arc Lamps.—M. Jacquin, in a recent issue of *L'Eclairage Electrique*, gives particulars of experiments he has made with a Broca arc lamp in connection with the production of blue and sun prints. The feature of the lamp in question is the use of carbons having a core of carbide of iron. The lamp in question was a hand-regulated one, placed on a 110-volt circuit, with a rheostat interpolated. The positive carbon, which forms small globules of iron, was, contrary to the usual method, placed below. The arc was fairly long, and regulated to take about 18 amperes at a difference of potential of from 30 to 35 volts. Behind the carbons was placed a vertical bent sheet of zinc, forming a reflector, and sending the rays on to a frame measuring 24 × 30 centimetres, and supported in a vertical position at a distance of 20 centimetres. Experiments were afterwards made with ordinary carbons of equal dimensions, with the same paper, the same intensity of current and the same distances. A fairly long arc was employed, corresponding to 48 volts, in order to give rise to violet rays. As a result of the tests it was found that the production of blue-prints, white drawings on blue with ferro-prussiate paper, or black drawings on a white ground on heliographic paper, could be done *three times more rapidly* with the carbide of iron arc than with the ordinary arc. M. Jacquin adds that the experiments he made have only a theoretical interest, inasmuch as they were made with a hand-regulated lamp. To be of practical use, the lamps would have to be provided with an automatic regulating device, which will require carefully thinking out, owing to the fact that the fusion of the carbide core tends to cause the carbons to stick together, after which it is difficult to get them apart. He concludes by recommending manufacturers of arc lamps to inquire into the matter of the production of a robust lamp with carbons having cores of carbide of iron, and to make comparative trials for themselves of such lamps with ordinary arc lamps and with those having closed globes.

The Curtis Steam Turbine.—This is another of those turbines of multiple effect by which the enormous velocity of flow of steam is reduced by passing it through a series of blades, none of which move at a velocity more than a fraction of the speed of the steam. Practically, such turbines consist of so many De Laval wheels separated by rings of fixed blades. Tests are said to have shown that, with steam at 140 lbs., a 600-kw. dynamo consumed 19·5 lbs. of steam per kilowatt-hour, when the vacuum was 28·5 in., the output being 475 kw., and the steam saturated. At 600-kw. output the steam consumption was 19·2, and at 775 kw. it was 19·1, showing a considerable range for economical operation. With 150° F. superheat, great economy was realised, the steam consumption being 17 lbs. at 450 kw., 16·75 at 600 kw., and 16·7 at 775 kw. A 5,000-kw. set is to be put to work shortly, and contracts are said to be in hand for many thousands of horse-power. Governing is effected by closing some of the steam nozzles, as is done, for example, in the Girard water turbine. The steam turbine appears to be making headway in America, which has followed British practice consistently after a few years' delay. Direct driving, which took hold so very slowly, will be a necessity with turbine work. Every steam turbine appears to differ very little from any other. They are all so many arrangements of curved vanes—in fact, so many steam Pelton wheels.

Personal.—Mr. A. Stewart, who is relinquishing the post of traffic manager for the Dudley and Stourbridge District Electric Traction Co. for an appointment with the City of Birmingham Tramway Co., has been presented by the employés of the former company with a gold Albert and seal, silver matchbox, pouch and case of pipes.

The Electricity in Mines Committee.—We read in the *Times* that the Home Secretary has appointed Mr. W. H. Patchell, member of the Council of the Institution of Electrical Engineers, to be a member of the Committee to inquire into the use of electricity in mines, in the place of Mr. James Swinburne, resigned.

For Sale.—Tenders are being invited for the goodwill, trade marks, &c., of H. M. Salmony & Co. (in liquidation). See our advertisement pages to-day.

British Electric Street Tramways.—The petition of Mr. A. J. Paine for winding up this company was first in the list of Mr. Justice Byrne's Court on Tuesday, but owing to its lengthy character, his Lordship directed the petition to stand over for a fortnight.

Annual Dinner.—The annual dinner of the electrical engineering departments of the Willesden and Tottenham Polytechnics (Middlesex County Council), was held at the Holborn Restaurant on Friday evening last, under the chairmanship of Mr. Frederic H. Taylor, who, in replying to a toast, referred to the excellent work which was being done by the engineering society connected with the Polytechnics, and to the educational value it undoubtedly possessed. The other toasts and speeches were interspersed with a programme of songs and sketches, arranged by Mr. Wm. Short.

Lectures.—Mr. J. T. Morris's course of lectures on "Three-phase Work" and "Electric Lighting" are to commence on Monday and Wednesday respectively next week, at the East London Technical College.

THE CENTRAL STATION ENGINEER.

The Reading Town Council has appointed Mr. Walter Binns, of Newcastle Corporation Tramways Department, to the position of tramways engineer, at a salary of £300 per annum. On Friday, May 1st, Mr. A. E. Le Rossignol, on behalf of the staff of the Newcastle Corporation power station, presented Mr. Binns with a silver rose bowl on an ebony plinth, and also a pair of silver flower vases, as a mark of esteem on the occasion of his leaving for Reading.

Mr. J. Arthur Sykes, who has left the Rhyl electrical works to fulfil an appointment at the Mansfield electrical works, was presented by the staff with a silver-mounted walking stick, suitably engraved.

Mr. J. C. Vaudrey has intimated his intention to resign the post of electrical engineer to Birmingham T.C. at the end of 1904, the term at which his agreement expires, but he asks to be relieved of his duties after July next. The Electric Supply Committee recommends that Mr. Vaudrey should be retained as consulting electrical engineer for a year at a fee of 500 guineas.

Salford T.C. on May 6th appointed Mr. James Scott Pringle as assistant electrical engineer, at £250 per annum (rising by £50 per year to £400.) Mr. A. C. Wright was also appointed engineer-in-charge.

The staff of the Middlesbrough Corporation Electricity Works held their first annual dinner on Wednesday, May 6th. The borough electrical engineer, Mr. Taylor, took the chair, and a most enjoyable evening was spent. It was followed by the usual "Smoker," and the success of the evening guaranteed it being continued annually.

Out of over 100 applicants, Mr. John Senior, assistant electrical engineer to Huddersfield Corporation, has secured the post of resident electrical engineer at Mexborough.

On Monday, 4th inst., at the electricity works, Leytonstone, Mr. T. W. Merry, who has resigned the position of charge engineer to take up a similar one at the King's Road Station of the St. Pancras Borough Electricity Department, was the recipient of a calculator and a case of pipes, presented to him by his old colleagues. The presentation was made by Mr. F. Harman Lewis, the engineer and manager, who paid a very warm tribute to Mr. Merry's ability and industry and wished him every success.

Mr. Stockbridge, junior assistant of the Bury electricity works, has taken up a position under the Westinghouse Co. at Trafford Park.

NEW COMPANIES REGISTERED.

Codd Arc Lamp Co., Ltd. (77,217).—This company was registered on April 29th, with a capital of £2,000 in £1 shares, to acquire the business and property of L. B. Codd (trading as the "Codd Arc Lamp Co.," at Nottingham), and to carry on the business of manufacturers of, and dealers in, arc lamps and accessories, the inventions of the said L. B. Codd, iron and brass founders, electricians, engineers, tool and implement makers, manufacturers of, and dealers in, gas, oil and electric motors, manufacturers of electrolytic apparatus, &c. The first subscribers (each with one share) are:—A. R. M. Simkins, 10, North Avenue, West Ealing, W., electrical engineer; L. B. Codd, Standard Works, Dame Agnes Street, Nottingham, electrical engineer; E. L. Thorpe, Standard Works, Dame Agnes Street, Nottingham, engineer; W. Robinson, 34, The Close, Nottingham, hosiery manufacturer; J. H. Scott, 13, Amburgh Road, Nottingham, machine builder; F. Roebuck, 16, High Road, Beeston, machine turner; and W. H. Facon, Nottingham, solicitor. No initial public issue. The number of directors is not to be less than two nor more than seven; L. B. Codd and A. R. M. Simkins are the first managing directors; remuneration as fixed by the company or by the board; qualification of subsequent directors, 150 shares. Registered office, Standard Works, Dame Agnes Street, Nottingham.

Lancashire Power Construction Co., Ltd. (77,202).—This company was registered on April 29th, with a capital of £300,000 in £1 shares (18,000 "A" and 12,000 "B"), to adopt an agreement with the Lancashire Electric Power Co., to sub-contract with the Edmundson's Electricity Corporation, Ltd., upon the terms mentioned in a provisional contract, dated April 28th, 1902, and to carry on the business of contractors for the construction, equipment and maintenance of generating stations and works for generating, storing, regulating, transmitting and supplying electrical energy for motive power, locomotion, lighting, heating, telegraphic or telephonic purposes, tramway and light railway constructors, electricians, mechanical engineers, accumulators and distributors of electricity, &c. The first subscribers (each with 50 shares) are:—F. E. Gripper, Broad Sanctuary Chambers, Westminster, engineer; W. B. Hopkins, Club House, Surrey Street, W.C., engineer; T. O. Callender, Hamilton House, Victoria Embankment, E.C., engineer; E. A. Carolan, 88, Cannon Street, E.C., engineer; W. R. Davis, 10, Moorgate Street, E.C., stockbroker; M. Barr, Temple Barr House, E.C., engineer; and N. Kennedy, 37, Walbrook, E.C., engineer. The number of directors is not to be less than three nor more than seven; the first are M. Barr, T. O. Callender, E. A. Carolan, F. E. Gripper, W. B. Hopkins and N. Kennedy; qualification, 50 shares; remuneration, £200 each per annum.

J. Bakewell & Co., Ltd. (77,192).—This company was registered on April 28th, with a capital of £15,000 in £1 shares (9,000 preference), to acquire the business of electrical and general engineers and ironmongers now carried on at 46, King William Street, E.C., and at Peterborough and Southend-on-Sea, as J. Bakewell & Co., to adopt an agreement with J. Bakewell and E. Bakewell, and to carry on the business of electrical engineers, manufacturers and constructors of cables, wires, lines, accumulators, lamps and works, electricians, suppliers of electricity, &c. The first subscribers are:—W. Bakewell, Volt Works, Atteroliffe, Sheffield, electrical engineer, with 500 shares; J. W. Farnsworth, Volt Works, Atteroliffe, Sheffield, manager, with 100 shares; E. Bakewell, 50, Narrow Street, Peterborough, electrical engineer, with 10 shares; J. Bakewell, 46, King William Street, E.C., electrical engineer, with 10 shares; J. H. Holme, 46, King William Street, E.C., accountant, with one share; W. H. J. Gore, 85, Windsor Road, Ilford, book-keeper, with one share; and H. H. Jones, 46, King William Street, E.C., electrician, with one share. Minimum cash subscription, 9,000 shares. The number of directors is not to be less than three nor more than seven. The first are J. Bakewell and E. Bakewell (managing directors), W. Bakewell and J. W. Farnsworth; qualification (except first managing directors), 100 shares; remuneration, £30 each per annum. Registered office, 46, King William Street, E.C.

Miller Signal Syndicate for India, Ltd. (77,174).—This company was registered on April 27th, with a capital of £2,500 in £1 shares, to acquire from A. S. Morrison the benefit of an agreement with G. Failing, of Mendota, U.S.A., on behalf of himself and W. H. Clinton, of Chicago, arising out of certain negotiations for the acquisition of certain patent rights, to adopt a proposed agreement with A. S. Morrison, G. Failing and H. C. Cooke, to acquire and turn to account the patents owned or controlled by the said G. Failing and W. H. Clinton for India, and to carry on the business of railway and other signal makers and installers according to the "Miller" system, electricians, engineers, suppliers of electricity, &c. The first subscribers are:—A. S. Morrison, The Lodge, Pinner, merchant, 100 shares: A. H. Morrison, 4, Leinster Gardens, W., gentleman, 100 shares; E. H. Jackson, 154, Leadenhall Street, E.C., advertising agent, 50 shares; J. E. Baxter, Oakfield, Farrington, Lancs., india-rubber manufacturer, 100 shares; R. Fegan, Westcombe Park, Blackheath, S.E., M.D., 50 shares; E. B. Morrison, 33, Greencroft Gardens, Hampstead, N.W., gentleman, 25 shares; and W. E. Reilly, Thorner's Chambers, Fenchurch Street, E.C., surgeon, 50 shares. No initial public issue. Registered without articles of association.

World's New Accumulator Co., Ltd. (77,227).—This company was registered on April 30th, with a capital of £7,500 in 1s. shares, to carry on the business of manufacturers of electrical accumulators, cycles, bicycles, tricycles, motor-cars, velocipedes, perambulators and carriages of every description, mechanical engineers, electricians, machinists, fitters, millwrights, founders, tube makers, saddlers, &c. The first subscribers (each with one share) are:—Cte. R. de F. Maunder, 1, Comeragh Road, West Kensington; Cte. de F. Maunder, 1, Comeragh Road, West Kensington; S. Schanschieff, 5, Stile Hall Mansions, Chiswick, W., engineer; G. Neville, Winchester House, E.C., solicitor; H. E. J. Williams, 81, Winchester House, articled clerk; E. R. Maunder, 80, Winchester House, E.C., clerk: and F. W. Merriman, Winchester House, E.C., solicitor. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; remuneration, £150 each per annum (£50 extra for the chairman), and 5 per cent. of the distributed profits after 5 per cent. dividend has been paid, divisible.

Kreiger Electric Carriage Syndicate, Ltd. (77,194).—This company was registered on April 28th, with a capital of £30,000 in £10 shares, to carry on the business of manufacturers of and dealers in motor-cars, motor-tractors, motor-vans, motor-cycles, velocipedes and carriages of all kinds, electrical, mechanical and general engineers, machinists, fitters, millwrights, founders, &c. The first subscribers (each with one share) are:—P. W. Northey, Ashtead Park, Surrey, electrical engineer; A. L. Shepherd, 8, West Kensington Gardens, W., electrical engineer; R. Paling, The Lodge, Effingham, Surrey, gentleman; C. W. Potter, 82, Sarfield Road, Balham, S.W., secretary; D. Buchan, 69, Fielding Road, Bedford Park, W., private secretary; W. H. Cocker, 45, Lupus Street, Belgravia, S.W., clerk; and H. G. Bach, St. Heliers, Sheepcote Road, Harrow, accountant. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first.

Craigpark Electric Cable Co., Ltd. (5,333).—This company was registered in Edinburgh on May 1st, with a capital of £150,000 in £1 shares, to carry on the businesses of manufacturers, buyers, sellers and dealers in cables (electric, insulating or otherwise), and all gutta-percha and rubber goods, whether for cables or otherwise, and all other works connected with telegraphic, telephonic and electric enterprises, manufacturers of cycles, or tires, golf, football or other balls, &c. The first subscribers (each with 250 shares) are:—J. T. Tullis, John Street, Bridgeton, Glasgow, merchant; W. S. Brown, Viewfield, Giffnock, merchant; W. B. Dick, 13, Exchange Place, Glasgow, merchant; C. Hamilton, 247, St. Vincent Street, Glasgow, electrical engineer; A. R. Maclean, Flemington Street, Springburn, Glasgow, managing director; J. Kellock, 26, Renfield Street, Glasgow, chartered accountant; and J. Dean, 1, Blythswood Drive, Glasgow, secretary. The number of directors is not to be less than three nor more than seven; the first are J. T. Tullis, W. S. Brown, W. R. Dick, C. Hamilton and A. Maclean; qualification, 250 shares; remuneration, £550 per annum, divisible. Registered office, Flemington Street, Springburn, Glasgow.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Woking Electric Supply Co., Ltd. (46,175).—Issue, on April 7th, of £800 debentures, and on April 18th of £300 debentures, part of a series created November 2nd, 1902, to secure £25,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Total amount previously issued of same series: £19,150.

Gravesend and Northfleet Electric Tramways, Ltd. (69,877).—A trust deed dated April 28rd, 1903, to secure £40,000 debenture stock (with power to make further issues up to half the issued capital) has been registered. Property charged: The company's assets, present and future. Trustees: Electric and General Investment Co., Ltd., 1—2, Great Winchester Street, E.C.

Eastern Telegraph Co., Ltd. (6,338).—£775 debenture stock created and dated April 22nd, 1903, as a first charge on the company's undertaking and revenue has been registered. Holder: F. R. de Livanté, 141, Hill Street, Peckham, S.E.

Minehead Electric Supply Co., Ltd. (74,382).—A debenture for £700, dated April 24th, 1903, charged on the company's undertaking and property, present and future, including uncalled capital, and a mortgage of even date, for the same amount (as collateral security), charged on land, engine house, store room, &c., at Minehead, have been registered. Holders: J. R. Paramore, Minehead, and the Rev. J. R. Paramore, jun., Iddesleigh Rectory, Devon.

J. E. H. Andrews & Co., Ltd. (Gas and Electrical Engineers, Stockport).—Issue, on April 29th, of £13,500 debentures, part of a series created October 27th, 1902, to secure £40,000, charged on freehold land at Reddish, Stockport, and to company's other assets, present and future, including uncalled capital. Trustees: W. Hobson, Suffolk Works, Sheffield; H. L. Faber, Lomond, South Hill Park, Bromley; and G. Johnson, Randall's Steam Joinery Works, Sheffield. Total amount previously issued of same series: £13,300.

ELECTRICITY SUPPLY ACCOUNTS.

Bristol Corporation Electricity Supply.

The returns of the Bristol Electrical Department show a noteworthy improvement over the two years preceding.

A reduction in working expenses and a great increase in output, particularly for power purposes, have served to earn a greatly increased profit over the previous year.

The progress of the undertaking will be gathered from the following figures:—

Year.	Units sold.	Equivalent 8-c.p. lamps connected.	Total revenue per unit.	Total cost per unit.	H.P. of motors installed.
1900	1,812,511	91,117	4·0d.	2·18d.	111
1901	2,191,559	119,615	3·9d.	2·62d.	377
1902	2,756,624	149,146	3·78d.	2·19d.	785
1903	3,409,758	182,134	3·62d.	1·71d.	1,288

In the two years preceding the department had to contend with high fuel costs and greatly augmented financial charges, due to the large works under construction, which did not contribute to the revenue. Mr. H. Faraday Proctor, the chief engineer, may now, however, be congratulated on having provided the city with the nucleus of an efficient power supply.

General Statement.

For the year ending March 25th—	1902.	1903.	Increase.
Total capital expended	£408,433	£458,289	£49,856
Units sold—Private lighting	1,965,794	2,945,085	—
Units sold—Power	310,054	688,740	—
Units sold—Public lighting	480,776	475,988	—
Total number of units sold	2,756,624	3,409,758	653,134
Equivalent 8-c.p. lamps connected	149,146	182,134	32,988
Number of public lamps	310 arcs 9 inc.	310 arcs 9 inc.	
Number of motors	150	262	112
Maximum load in kw.	2,535	2,831	296
Revenue Account—			
Gross revenue	£43,261	£51,373	£8,112
Gross expenses	£25,227	£24,208	—£1,019
Gross profit	£18,034	£27,165	£9,131
Average price per unit sold	3·60d.	3·44d.	—·16d.

The units sold show an increase of 653,134 over the previous year, the most noteworthy increase being in power units, which are 688,740, as against 310,054 in 1902. The prices charged per unit have been (since 1900) for private lighting, 5d. to 2·33d. per B.T.U.; power, 1½d. with discounts. Public lighting £23 per lamp, including attendance and repairs.

Revenue Statement.

	1902. Gross.	1902. Per unit.	1903. Gross.	1903. Per unit.	Inc.
Sale of energy	£41,369	3·60d.	£48,844	3·44d.	—·16d.
Meter and motor rents	1,644	·14d.	2,173	·15d.	·01d.
Rents, fees, premiums, &c.	153	·02d.	275	·02d.	·00d.
Sundry	95	·01d.	81	·00d.	—·01d.
	£43,261	3·77d.	£51,573	3·61d.	—·16d.

The works costs show a reduction of nearly ½d. per unit sold, and over £1,000 in total, compared with the previous year. In the matter of coal costs, a reduction of 27 per cent. has been made, and although this is to some extent due to the lower price paid for fuel, it is also largely attributable to the economical working of the new Avonbank generating station, which was opened in February, 1902. The summary of costs for the two stations show that while at Temple Back the coal cost per unit was ·75d., at Avonbank it was only ·4d., the figures for works and distribution costs being 1·21d., and ·84d. respectively, and it is only reasonable to suppose that as the newer plant becomes more fully loaded, its figures will show a corresponding improvement.

The capacity of the works (alternating and direct-current plant) is—Temple Back 3,216 kw., and Avonbank 1,820 kw., a further 1,500 kw. of plant being on order for the latter station.

Working Expenses.

	1902. Per unit.	1902. Gross.	1903. Per unit. Temple Back.	1903. Per unit. Avonbank.	1903. Total.	Inc.
Coal	·91d.	£9,367	·75d.	·40d.	·66d.	—·25d.
Oil, waste, water, and engine room stores	·06d.	723	·05d.	·05d.	·05d.	—·01d.
Salaries and wages incurred in generation and distribution	·28d.	4,450	·25d.	·32d.	·31d.	·03d.
Repairs and maintenance of machinery, plant, buildings, &c.	·30d.	2,509	·15d.	·03d.	·18d.	—·12d.
Works and distribution costs	1·55d.	£17,049	1·21d.	·84d.	1·20d.	—·35d.
Rent, rates and taxes	·19d.	2,493	—	—	·18d.	—·01d.
Management expenses, salaries of engineer, secretary and clerical staff	·26d.	3,069	—	—	·22d.	—·04d.
General establishment charges, stationery, printing, law, insurance, and electrical inspector's salary	·19d.	1,597	—	—	·11d.	—·08d.
Total cost	2·19d.	£24,208	—	—	1·71d.	—·48d.

The increase of revenue of £8,112, coupled with a decrease in costs of £1,019—produced a profit of £27,165, being an increase of £9,131 over the previous year. Out of this sum, after providing for augmented financial charges, a balance of £5,872 remained, which was allocated as shown.

The reserve fund, which benefited by £1,491, now stands at £6,000, and the depreciation account, although credited with £4,368, has had at the same time large withdrawals and remains at £3,400.

Profit Statement.

	1902.	1903.
Interest, &c.	£10,946	£11,936
Sinking fund	8,084	9,257
Reserve fund	—	1,491
Depreciation	—	4,368
Balance for year	—996	13
Gross profit	£18,034	£27,165

Borough of Accrington Electricity Supply.

The accounts for the second complete year's working of the Accrington electricity department show that both the output and gross profit have nearly doubled during the year.

The generating plant is worked in conjunction with a refuse destructor, and the combined costs of coal and heat for the year amount to ·42d. per unit—a considerable increase upon the previous year, although as a whole works costs are over ½d. per unit less. Of the total 175,884 units supplied, 129,986 units at an average price of 4d. per B.T.U. were taken by private lighting, 9,988 B.T.U. at an average price of 3d. per unit by street lighting, 16,470 units for power averaged 2·24d., and 19,440 units credited to the destructor's account averaged 2d.

The prices charged for lighting were 5d. for the first hour and 3d. after; power, 4d. first hour and 1½d. after. Mr. H. Gray is the borough electrical engineer.

General Statement.

For year ending December 31st—	1901.	1902.	Inc.
Total capital expended	£36,979	£42,516	£5,537
Number of units sold	97,869	175,884	78,015
Equivalent 8-c.p. lamps connected	10,446	16,798	6,352
Number of public lamps	4	40	36
Maximum load in kilowatts	142	194	52
Revenue Account :—			
Gross revenue	£1,622	£2,878	£1,256
„ expenditure	£1,129	£1,552	£423
„ profit	£493	£1,326	£833
Average revenue per unit sold	3·88d.	3·58d.	—·30d.

Revenue Statement.

	Gross.	Per unit.
By sale of energy	£2,621	3·58d.
Hire of motors	37	·04d.
Street lighting and bell maintenance	91	·12d.
Premium and sundries	129	·18d.
	£2,878	3·92d.

Working Expenses.

	Gross.	Per unit.
Coal and cartage	£146	·20d.
Heat from destructor	162	·22d.
Oil, waste, water and engine room stores	110	·15d.
Wages incurred in generation and distribution	423	·58d.
Repairs and maintenance of plant, cables, &c.	94	·13d.
Works and distribution costs	£935	1·28d.
Rents, rates and taxes	£173	·22d.
Management expenses, salaries of engineer and clerical staff	372	·52d.
General establishment charges, printing, stationery, insurance, &c.	72	·10d.
Total working expenses	£1,552	2·12d.

Profit Account.

Interest	£1,105
Sinking fund	1,545
Deficit on year's working	—1,324
Gross profit on year	£1,326

A gross profit resulted on the year's working of £1,326—a sum which had to be supplemented by £1,324 out of the rates in order to meet the financial charges of £2,650, a figure equal to 7·17 per cent. on the capital employed. It will be noted that, despite the increased financial charges, the deficit on the year's working shows a considerable decrease, being £1,324 as compared with £1,558 in the previous year.

The total cost per unit sold, including financial charges, amounts to 5·73d., as compared with 7·79d. in the preceding year.

CITY NOTES.

Calcutta Electric Supply Corporation.

The sixth annual general meeting of the shareholders of this company was held on Thursday of last week, Colonel A. J. Filgate, R.E., presiding. The report, which had been submitted to the shareholders, reads as follows:—

The result of the year's working has been satisfactory. The number of units of electrical energy sold during the year was 1,552,775, compared with 962,958 for the preceding year. The gross revenue from all sources amounted to £35,124, compared with £23,248. The working costs were £21,990, compared with £14,602. The net result of the year's operations, after making provision for future maintenance and repairs, is a profit of £13,133, compared with £8,646 in the preceding year. Exchange is calculated at 1s. 4d. per rupee. The progress of the company will best be observed from the following figures:—

Year.	Houses.	Equivalent connections in 8-c.p. lamps.	Units. sold.	Gross revenue.	Net revenue.
1900 ..	407	28,586	412,950	£11,147	£5,394
1901 ..	699	56,597	962,958	£23,248	£8,646
1902 ..	965	80,762	1,552,775	£35,124	£13,133

In July last year, by resolution of the shareholders, the capital of the company was increased from £200,000 to £500,000, and the directors issued 20,000 additional shares at a price of £6 per share. The premium on this issue, £20,000, was placed to the reserve account, which now amounts to £35,000. The capital expenditure during the past year has been very large, owing to the rapidly growing demand for electrical energy in Calcutta and the necessity for increasing the plant and mains. The total outlay has been £115,014, the greater part of which, of course, has not been productive of additional revenue during the year. The principal items of capital expenditure are £42,649 on plant and machinery, £9,795 on freehold land and buildings, £57,944 on mains, £2,585 on meters, £1,015 on electrical instruments. The total capital expenditure at December 31st last amounted to £295,653. The directors have set aside a sum of £7,000 for the renewal fund account. Of this sum £3,247 2s. has been expended, leaving a balance of £3,752 18s. to be added to the £5,599 9s. 4d. brought forward from last year, making a total of £9,352 7s. 4d. carried forward. To the net profit of £13,133 9s. 4d., there has to be added the sum of £594 16s. 4d., brought forward from last year, and £74 14s. 6d. interest on deposits, making a total available balance, after deducting the interim dividend paid on November 11th last, of £8,275 11s. The directors recommend a final dividend for the half-year at the rate of 7 per cent. per annum on the paid-up share capital, making, with the interim dividend, 6½ per cent. for the year, and the balance, £602 5s. 1d., to be carried forward. The work of electrical supply has been good, and there have been only a few troubles with the mains. Some of the generating plant in the Emambagh Lane Station was seriously damaged by lightning during a severe thunderstorm, necessitating the hiring of temporary plant and other heavy charges on the renewal fund, including the cost of sending some of the machinery to London to the makers' works. Arrangements have been made which, it is believed, will prevent the possibility of a recurrence of such damage in the future, and the repairing shop is being equipped with additional appliances capable of dealing with the largest machines. Licenses for the electric lighting of the Howrah Bridge, and for the supply of electrical energy in the Howrah district of Calcutta have been granted by the Government during the year. The board have sanctioned the purchase of a site in the northern part of the town for a third station in Calcutta, the design and equipment of which are under consideration.

In moving the adoption of the report, the Chairman said that, considering the large additional capital outlay which they had been obliged to incur, in order to keep pace with their expanding business, and the heavy outlay on repairs and maintenance that had to be met, the result was satisfactory. At the end of 1901 they had 708 customers on their books with lamps and motors to the equivalent of 56,284 8-c.p. lamps; at the end of 1902 their customers had increased to 965, and the lamps and motors connected, to the equivalent of 80,762 8-c.p. lamps. Each week's mail brought them lists of fresh demands. The native population were now applying more freely for electric current. Calcutta, however, was a very large city, and, in spite of the work already accomplished, there was still a great deal to be done in bringing the mains to many would-be customers. They believed that, as the value of electricity became more generally known, a large demand would arise among the native population. Among the European population, the use of electricity was steadily increasing, and they were informed that almost every new house built in the European quarter was now wired by the landlord both for lighting and fans. The use of electricity for driving machinery was also on the increase, and a fair day-load might be expected at no distant date. As they told them last year, they had to face heavy additional capital outlay to keep up with the increasing demand for electricity throughout the city; and the expenditure during the year had amounted to £115,014, bringing the total up to the end of the year to £295,653. The plant in use at the end of 1901 was the equivalent of 976 kw., and at the end of 1902 that had been increased to 1,425 kw. At an early date, the plant at the two stations will consist of:—Two 750-kw. sets, three 228 ditto, three 225 ditto, two 115 ditto, four 38 ditto—total, 3,241 kw. The outlay on mains and mains materials had amounted to £57,944. They had increased the length of the underground feeders during the year by about 12 miles, had laid about 5 miles of underground, and about 15 miles of overhead distributing mains. Their total length of underground feeders and mains was now about 39½ miles, and overhead feeders and mains 38½ miles, or 78 miles in all. These were large figures, but they were fully justified by their progress. To meet that outlay they issued 20,000 new £5 shares last August at a premium of £1 per share, which were promptly taken up by the shareholders. The premiums realised on that issue had been credited to reserve account, increasing this account to £35,000. They had now under consideration the design and equipment of a new station, which they proposed to erect at the northern end of the city. The units sold during the year amounted to 1,552,775 compared with 962,958 sold in 1901. The net receipts from the sale of electricity amounted to £31,765, meter rents to £1,220, rent of fans to £1,643; altogether the gross revenue, including £269 for dividends on investments, reached £35,124 compared with £23,248 realised in 1901. On the expenditure side of the account, the outlay on generation and distribution of electricity had amounted to £9,431 compared with £5,516 in the previous year; the increase was chiefly due to the additional work performed and the working of the second station at Alipore. The outlay under repairs and maintenance amounted to £3,247 compared with £1,901 in 1901. The increase was attributed to the additional length of mains they had to maintain, to repairing damage done to machinery by lightning, and other causes. Management expenses had amounted to £4,968 against £3,472 in 1901. Altogether, the actual expenditure for the year, including the appropriation made to the renewal fund account, had amounted to £21,990 as compared with £14,603 in 1901. The balance of the net revenue account, after providing for the sum credited to the renewal fund account, amounted to £13,133. Out of this they paid the interim dividend for the first half-year at the rate of 6 per cent. per annum, which absorbed £5,327, and they now recommended a final dividend at the rate of 7 per cent. per annum, making 6½ per cent. for the year, and to carry the balance, £602, forward. Their prospects continued most encouraging. The demand for electricity was steadily increasing, the demand for lighting increasing more than the demand for power. Up to April 10th the units delivered this year had reached 420,040 compared with 300,349 units delivered up to the same date last year, an increase of nearly 40 per cent. They were now engaged in preparing to light the Hoogley Bridge under contract, and had arranged terms for lighting the jetties for the Port Commissioners. They had obtained the concession for the supply of electricity in Howrah. That project promised to yield a satisfactory return on the capital needed for the installation.

Mr. E. Boulnois, M.P., seconded the motion, and the report was adopted.

Elmore's German and Austro-Hungarian Metal Co.

Mr. John MacFarlan presided at the annual meeting held at Winchester House on Monday. In moving the adoption of the report, he said that the weight sold during 1902 was more than that sold during any previous year of the company's history, and the trading profit was accordingly larger, but, on the other hand, the profit and loss items were larger owing to increases in interest and depreciation. The trading profit not only did not include any profit on copper, but was arrived at after they had written down a portion of their manufactured stock. While the stock stood in the books at M. 916,329, its actual market value was at least £7,500 more. The German law was somewhat drastic with regard to depreciation; during the past 10 years they had written off no less than £24,000 for depreciation, and in addition had spent £5,800 for repairs and maintenance of plant and machinery, all of which had been charged to revenue. Under such conditions it was very difficult to show substantial profits. He did not contend that such a course was not the better one to adopt from a business point of view, but seeing that the plant had been kept up to a very high state of efficiency, and was, in fact, as good as, if not better than, when they started, owing to its being fitted with the latest improvements, it did seem that they were leaving a considerable amount to posterity at the company's expense. The debenture interest was the great incubus that weighed the company down and retarded progress. He reminded the preference holders that during the past 10 years the company had paid in cash little less than £50,000 on account of interest on debentures and loans, and while the debentures were paid so high a rate as 8 per cent., the difficulty of paying large dividends on the shares must be very great. But it was no use bemoaning their fate; they had to find some means of producing more cheaply. The manufacture of small tubes by the Elmore process had proved to be the most expensive portion of their trade; they had to take from the tank a 4-in. tube and spend a considerable amount of money in drawing it down, and for this they did not receive an adequate return. As the Elmore process had now become world-wide in its reputation for large diameters, they had come to the conclusion that it would pay them better to produce the large diameters by the Elmore process and the small diameters by a cheaper and quicker process. With that object in view, the managing director and the works' manager visited the United States of America, and as a result of their inquiries it was decided to instal a small plant for the production of small tubes; this plant would be at work in the autumn. He did not promise that the installation of the machine would bring the company very large profits, for, to a considerable extent, it was an experiment, but they honestly believed it would perform all that they desired, and that it would materially increase the earning power of the factory at Schladern. They had acquired the sole rights for Germany, and the price paid for the rights and the machine, which was being constructed in America, was by no means high, and the amount could, they believed, be paid without having to ask the shareholders for money. The output was still increasing. They had reached quite high figures, and the demand continued to be good. Throughout the great crisis in Germany during the last two years, this company had had an abundance of work. The directors visited the factory on 28th ult., and found it in good order. The new engine house and the two 200-h.p. engines, which were purchased last year, had been completed. There was now ample reserve of power in the event of drought.

The motion was seconded by Mr. J. Heal, and, after a few questions had been put and answered, the report was adopted. The retiring directors and auditors were re-elected.

Castner-Kellner Alkali Co.

The report for the year ended March 31st last, states that the net profit for the year, after keeping up the works, plant and machinery to the highest state of efficiency, is £59,072. To this has to be added the amount brought forward, £6,590; total, £65,662. Deducting interim dividend at the rate of £6 per cent. per annum paid for the six months ending September 30th last, and debenture interest, there remains an available balance of £41,652. Out of this the directors recommend that £15,000 be appropriated to depreciation reserve, increasing that account to £55,000; that a dividend at the rate of 6 per cent. per annum be paid for the six months ended March 31st, amounting to £13,500, and making, with the interim dividend paid in November last, 6 per cent. for the year, leaving to be carried forward a balance of £13,152.

Western Telegraph Co.

The directors report that the revenue for the half-year ended December 31st, 1902, amounted to £225,995 10s. 11d., and the working expenses to £78,846 2s. 2d. After providing £13,421 0s. 2d. for debenture stock and debenture interest and sinking fund, and £3,370 11s. 2d. for income-tax, there remains a balance of £130,357 17s. 5d.; to this is added the sum of £4,352 18s. 2d. brought forward from June 30th last, making a total of £134,710 15s. 7d. First and second interim dividends, amounting to £62,379, have been paid, and after transferring £65,000 to the general reserve fund, and £2,000 to the maintenance ships' reserve fund, there remains a balance of £5,331 15s. 7d., which is carried forward to the next account. The revenue includes £11,806 11s. 6d. dividends upon the company's investments in other telegraph companies. Although the directors are unable to report any appreciable improvement in the general trade with South America during the half-year under review, the firmness of exchange is a satisfactory feature, and the prospects for the current period are more encouraging.

Globe Telegraph and Trust Co.

The balance-sheet and accounts for the period July 19th, 1902, to April 30th, 1903, show that the net revenue of the company for the period, after deduction of expenses, amounts to £137,033, and makes, with the balance of £956, a total of £137,390. From this amount there has been distributed the sum of £82,611 in interim dividends, leaving an available balance of £54,778. The directors recommend the payment of a final dividend of 3s. 5d. per share for the period from January 19th to April 30th, 1903, on the preference shares, and of 2s. 6d. per share on the ordinary shares for the same period, making, with previous distributions, total dividends for the period at the rate of 6 per annum, less income-tax, on the preference, and of £3 16s. 7d. per cent. per annum net on the ordinary shares, leaving a balance of £3,071 10s. 5d. to be carried forward to the next account.

West India and Panama Telegraph Co.

The directors' report for the half-year ended December 31st, 1902, reads as follows:—

The amount of credit of revenue is £31,062 17s. 6d., against £25,243 16s. 0d. for the corresponding half-year of 1901. The expenses have been £20,679 4s. 5d., against £19,836 14s. 8d., leaving a balance of £10,383 13s. 1d., to which is added £2,567 18s. 3d. interest on investments, and £2,797 19s. 8d., brought from last account, making a total of £15,739 6s. 0d., with which it is proposed to deal as follows:—

Payment of 8s. per share on account of arrears of dividend to December 31st, 1902, on the first preference shares	£13,825	4	0
Balance to current half-year's account	1,914	2	0
	£15,739	6	0

The cost of repairs to cables during the half-year amounted to £7,674 17s. 4d., in addition to which £7,176 2s. 3d. has been charged to reserve. This latter expenditure is due to the laying-in of 70 knots of new cable in the repair and part renewal of the St. Lucia—Grenada and the St. Lucia—St. Vincent sections which were interrupted by the eruption of the St. Vincent Soufrière in May. As detailed in the last report, the latter cable was again interrupted by volcanic disturbances which from time to time have since been renewed both in St. Vincent and Martinique. At present, therefore, it has been found impracticable to repair this cable and the two sections connecting Martinique. The new repairing steamer *Henry Holmes* which is to replace the *Grappler*, was successfully launched on the 2nd ult. and will probably be delivered in the course of a few days. A contract has been entered into with Messrs. Siemens Bros. & Co. for the manufacture and shipment of 250 knots of deep-sea cable for stock, which will be sent out to the West Indies in the new ship.

Underground Electric Railways of London.—Reuter's New York office reports that Messrs. Speyer & Co.'s Syndicate, which has taken £7,000,000 worth of 5 per cent. Five-Years Profit-Sharing notes of the Underground Electric Railways Co. of London, will shortly offer £5,000,000 worth of the same at a price somewhat below par. It is reported that the number of directors of this company is to be increased to 15, and the following gentlemen have been chosen as new directors of the company:—Mr. Edgar Speyer, of London; Mr. T. Jefferson Coolidge, jun., of Boston; Mr. Henry Teixeira de Mattos, of Amsterdam; and the following gentlemen of New York City, namely—Mr. James Speyer, Mr. James A. Blair, Mr. L. F. Loree, Mr. Robert H. McCurdy, and Mr. James H. Hyde.

South London Electric Supply Corporation.—The company report having sold during the first quarter of the year 376,227 units, as against 279,306 units for the corresponding quarter of last year, showing a gross revenue of £7,279 as against £5,804, or an increase of over 25 per cent.

Stock Exchange Notice.—The Committee has been asked to allow the following to be quoted in the Official List:—Mather & Platt, Ltd.—Further issue of 7,495 5 per cent. cumulative preference shares of £10 each.

Midland Electric Corporation.—It was stated on Wednesday that the final batch of allotment letters had been posted.

STOCKS AND SHARES.

Wednesday Evening.

With so much public money released in consequence of the Transvaal Loan allotments, the promise of business which we ventured to suggest a week ago is showing signs of development. The electrical supply market has nothing to complain about, and there is a lot doing in traction varieties. Telegraph stocks exhibit little change, but their twin-sisters in the telephone department command a good deal of public attention.

Deep is the disappointment amongst small investors in regard to the way in which the Transvaal Loan has been parcelled out. Of course, it goes without saying that the practice of sending in applications for little amounts of stock was shamefully abused, and many are the stories afloat of the way in which the "clever" people filled in dozens of forms in fanciful names. But the sense of resentment against the Bank of England with which the *bonâ fide* small investor is filled, may possibly be extended to the Stock Exchange, in which case there may not, after all, be that all-round quickening of trade that it was hoped the new Loan's advent might bring in its train.

Turning to details, the Electricity Supply section furnishes a number of fluctuations. A fall of 10s. in Metropolitans is not ascribable to the new issue of Preference shares which will shortly be made, but has its origin in renewed uneasiness in connection with the eternal difficulties over the Marylebone matter. The most recent cause of trouble lies in the reported disability of the local authorities to come to any agreement whatever with the company, and it is stated that they had actually no power to negotiate, which adds one more knot to the already tangled skein. As to the new issue of 4½ per cent. Preference shares, this will probably be made in the proportion of one new for every existing two, and the price to the shareholders will be par, *i.e.*, £10 apiece. Such an excellent investment is hardly likely to be discountenanced by the proprietors next week, when the matter comes up for confirmation at the meeting.

City of London Ordinary have improved still further on the capital quarterly showing published by the company, a showing which encourages bright hopes for the next dividend. The Preference shares, however, are rather lower, as are also Edmundson's Preference and South London Ordinary. Some people seem to think that the last-named are still valued quite highly enough, although the gross revenue is displaying a good increase. Westminster Preference recovered the 5s. lost last week, but eased off again; St. James's Preference are ½ better. In the Debenture list, Knightsbridge and Kensington Fours have improved to 104½, and Charing Cross Debenture is 1 up. In connection with the Charing Cross Co., there is a talk of more money being required for the City undertaking, and another issue of Preference shares is suggested.

As regards the railway list, City and South London Ordinary remains dull upon the prospect of competition, as already mentioned, and, like Central London Ordinary, has shed a point. Waterloo and City keeps steady at a trifle over par, Mersey Stock at 14 is uninfluenced by the remarkable expansion that the electrification of the line has already wrought in the traffic receipts—although the increase may be partly due to the novelty-seeking passengers—and the Underground descriptions are, if anything, a shade lower. Great Northern and City Preferred shares continue to change hands at about 8⅞.

London United Tramways issues are neglected, and therefore incline to droopiness. The Preference at 11⅞, and the Debentures at 106½, keep dull company with the Ordinary shares about 22. Buenos Ayres and Belgrano have hardened to 2⅞, those who bought the shares lower down might be well advised to secure their profit now and await an opportunity for repurchasing more cheaply later on. British Electric Tractions keep a firm market, but there is no change in the prices.

Shareholders in the British Insulated Wire and Helsby Cables are not viewing with any pleasure the recent offer by their company of the Midland Electric Corporation's capital. B.I. Co.'s shares are down to 6¾, and the Preference to 5¾, while even the Debenture stock is affected to the extent of a point. Brush shares have dropped 5s., and the amended time for making the exchange into British Electric Traction shares expires on the 16th inst.

Renewed dullness in the Anglo-American group is the only outstanding feature amongst telegraph securities, and in these the changes do not go beyond declines of ¼ and 1 in Anglo "A" and Anglo Ordinary respectively. The Eastern descriptions are unchanged, but here and there a Debenture issue is the turn lower. National Telephone Deferred shows a 1 per cent. rise, and the rest of this company's stocks are steady. Orientals have lapsed to a fraction under par, and United River Plate Telephones lost their rise when the adjacent Argentine Railway market began to feel the pressure of profit-taking sales.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations May 6th.	Closing Quotations May 13th.	Business done week ended May 13th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	97 —101	97 —101	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¾— 3¼	2¾— 3¼	..	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	61s.	60/6	48 — 51	47 — 50	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	89 — 91	89 — 91	89¾	89
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	8¼— 9¼	8— 8¾	8¼	8¼
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	..	4¼— 5¼	4¼— 5¼	..	..
18,333,300$	Commercial Cable	$100	8 %	8 %	..	155 —165	155 —165	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	89 — 92	89 — 92	91	89½
16,000	Cuba Telegraph	10	4½%	4 %	6½%	6¼— 7¼	6¼— 7½	..	..
6,000	Do. 10 % Pref.	10	..	..	..	14¼— 15½	14¼— 15½	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2¼— 3½	2¼— 3½	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
30,000	Do. do. 4½ % Debs.	50	..	..	..	99 —102	.. — ..	..	..
60,710‡	Direct United States Cable	20	3½%	3½%	..	9 — 10	9 — 10	9	..
92,800‡	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	117 —122	117 —122	120	118
1,955,555	Do. 8½ % Pref. Stock	100	..	..	..	88 — 86	88 — 86	84½	..
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	104 —107	104 —107	104	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11 — 12	11 — 12	11½	11 1/16
320,000‡	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —108	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	101 —104 %	101 —104 %	101	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	8¼— 9	8⅝— 9	8⅝	8¾
180,042	Do. do. 6 % Pref.	10	..	..	..	12 — 13	12 — 13	12 1/16	12
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	23 — 25	23 — 25	23	..
66,300‡	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	36 — 40	36 — 40	..	..
100,000‡	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —104	100 —104	102	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	99 —101	99 —101	100½	99
1,966,667	Do. do. Def. Stock	100	..	..	4½%	77 — 79	78 — 80	78½	77
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	..	..
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5⅝	5¼— 5⅝	..	..
2,000,000‡	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 — 99	97 — 99	99⅛	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	102 —104	102 —104	103½	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	⅝— 1 1/16	⅞— 1	⅞	..
100,000‡	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6¾— 7¾	6¾— 7¾	..	..
3,308	Submarine Cables Trust	Cert.	..	..	..	102 —112 xd	102 —112	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	5⅝— 6⅜	5¾— 6	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4¾— 5⅛	4¾— 5⅛	..	..
179,947‡	Do. do. 5 % Debs.	Stock	..	..	..	105 —108	105 —108	..	..
15,609	West African Telegraph, Shares	10	..	..	..	3 — 4	3 — 4	..	..
30,008	West Coast of America, Nos. 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	0 — ¼	0 — ¼	..	..
150,000‡	Do. do. 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	92 — 97	92 — 97	..	..
267,280	Western Telegraph, Ltd., Nos. 1 to 207,280	10	7 %	7 %	..	11 — 12	11 — 12	11½	11
75,000‡	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	96 — 99	96 — 99	96⅜	96
88,321	West India and Panama Telegraph	10	¼%	..	..	⅜— ⅝	⅜— ⅝	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6½— 6⅞	6½— 6⅞	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3½— 4¼	3¼— 4¼	..	..
80,000‡	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	99 —102	99 —102	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
300,000‡	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	73 — 78 xd	75 — 80	..	..
100,000	British Electric Traction	10	9 %	9 %	..	13¾— 14¼	13¾— 14¼	14¼	13 1/16
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	12 — 12⅝	12 — 12⅝	12 5/16	12 5/16
600,000‡	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	122 —125	122 —125	124½	124
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	8 — 8⅛ xd	7⅝— 8	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅝— 6⅛	5⅝— 6⅛	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	108 —107	108 —107	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	7/- — 7/6	6/- — 7/-	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	16s. to 17s.	16s. to 17s.	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	1 — 1¼	1 — 1¼	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1¼ — 1⅝	1¼ — 1⅝	..	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	89 — 94	89 — 94	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	..	13 — 14	13 — 14	13¼	13
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5⅜— 6	5⅜— 6	5⅝	..
90,000‡	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	108 —112	108 —112	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	106 —109	106 —109	..	..
494,093	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	108 —106	108 —106	105	..
494,993	Do. do. Def. do.	Stock	..	4 %	4 %	109 —112	108 —111	110	109½
1,320,000	City and South London Railway	Stock	1½% 1892	2 %	3½%	73 — 75	71 — 73	73	72
85,000	Crompton & Co., Nos. 1 to 85,000	5	8 %	7½%	..	2¾— 2¾	2¾— 2¾	..	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	102 —106	102 —106	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1¼— 2⅛	1¼— 2⅛	..	..
344,023‡	Do. do. 4 % Deb. Stock Red.	100	..	..	..	73 — 77	73 — 77	..	..
100,000‡	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 80	75 — 80	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1¼ — 2	1¼ — 2	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2¼— 3	2¼— 3	..	..
82,500‡	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	100 —103	100 —103	..	..
35,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	10 — 10½	10 — 10½	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	99 —102	99 —102	..	..
85,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	15 — 16	15 — 16	..	..
35,090	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5⅛	5 — 5⅛	5⅜	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	107 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½— 19½	18½— 19½	18⅝	..
800,000‡	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 — 103	..	..
27,500	†Liverpool Overhead Railway, Ord.	10	8½%	12½%	12½%	5 13/16—15 13/16	5 13/16— 5 13/16	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10½— 11	10½— 11	..	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	34 — 37	33 — 36	35½	33½
150,000‡	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000‡	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	98 —101	99 —102	101	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 1/- —2/-.
National Electric Fires Wiring, 14/- —16/-.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—14¾.
Do. do. Pref (£10 pd.), 10—10½.

Bank rate of discount 4 per cent. (October 2nd 1902)

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations May 6th.	Closing Quotations May 13th.	Business done week ended May 13th, 1903. Highest.	Lowest.
		‡							
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	1	..	..	..	1/8 — 7/8	1/8 — 7/8	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	118 —121	118 —121	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	6 %	8 %	8 %	10¼— 11	10¼— 11	10½	10⅛
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10¼— 10⅜	10¼— 10⅜	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9⅛	9 — 9⅛	9⅛	9⅛
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5⅜— 5⅜	5⅜— 5⅜	..	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4½— 5⅛	4½— 5⅛	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	105 —107	106 —108	..	..
44,486	*Chelsea Electricity Supply, Ord.	5	5⅛%	4 %	4⅛%	6 — 6⅞	6 — 6⅛	..	..
150,000	Do. do. % Deb. Stock Red.	Stock	..	..	..	109 —112	109 —112	110⅛	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	0 %	5 %	5 %	11 — 11½	11½ — 11⅝	11⅝	10⅞
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13½— 14½	13 — 14	13⅞	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	123 —127	122 —127	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	103 —106	103 —106	105	104½
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	8 — 9	8 — 9	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	12 — 13	12 — 13	12½	..
400,000‡	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red	..	..	..	..	110 —113	110 —113	111½	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	6¾— 7⅛	6¾— 7⅛	6⅞	6¾
50,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6½— 6¾ xd	6 — 6⅜	6⅜	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	107 —110	107 —110	109	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	11 — 12	10 — 11	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	100 —106	100 —103	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	2⅜— 2⅝	2⅜— 2⅝	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5⅜— 6	5⅜— 6	5⅝	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —103	100 —103	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6¾%	7½%	17⅛— 18⅛	17 — 18	17⅝	17⅜
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —115	110 —115	113½	112⅝
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	98 —101	98 —101	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	14 — 15	14 — 15	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15⅝— 16⅜	15⅝— 16⅜	16	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8½ — 9½	9 — 10	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —101	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3 — 3⅛	3 — 3⅛	..	..
50,000‡	Do. do. 4% Deb.	100	..	..	..	88 — 93	88 — 93	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1½%	3½ — 4	3¾ — 4	3⅞	3⅞
30,000	Urban Electric Supply, Ord.	5	..	..	..	4⅞— 5⅛	4⅞— 5⅛	..	..
30,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4⅞— 5⅛	4⅞— 5⅛	5	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12 — 13	12 — 13	12½	..
28,141	Do. do. 5 % Cum. Pref. .. ..P	5	..	..	..	6½— 6⅝	6½— 6⅝	6⅝	6⅝

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, May 13th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£21	dec.
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	3d.	..
a ,, Caustic (75/80%)	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	121/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a ,, Bichromate, casks	per lb.	2½d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£130	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
p Babbitt's metal ingots	per ton	£43 to £145	..
c Brass (rolled metal 2" to 12") basis	per lb.	7½d.	¼d. inc.
c ,, Tube (brazed)	per lb.	9½d.	..
c ,, ,, (solid drawn)	per lb.	7¾d.	..
c ,, Wire, basis	per lb.	7½d.	¼d. inc.
c Copper Tubes (brazed)	per lb.	9½d.	..
c ,, ,, (solid drawn) ..	per lb.	9¾d.	..
g Copper Bars (best selected ..	per ton	£75	..

METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g Copper Sheet	per ton	£75	..
g ,, Rod	per ton	£75	..
e ,, (Electrolytic) Bars ..	per ton	£72	..
e ,, ,, Sheets ..	per ton	£83	..
e ,, ,, Rod ..	per ton	£73 10	..
e ,, ,, H.C. Wire	per lb.	9¾d.	..
f Ebonite Rod	per lb.	3/-	..
f ,, Sheet	per lb.	5/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	3/10½ to 3/11½	..
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	47/8	1s. inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£12 7 6	..
g ,, ,, Sheet	per ton	£14 10	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 12 6	..
d Mica (in original cases) small ..	per lb.	3d. to 1s.	..
d ,, ,, ,, medium	per lb.	2s. to 3/3	..
d ,, ,, ,, large ..	per lb.	3/6 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/2	..
o Platinum	per oz.	£4	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	..
i Stee., Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£136 to £137	20s. dec.
g ,, Foil	per lb.	1/6½	..
n ,, Wire, Nos. 1 to 16	per lb.	1/9	..
p White Anti-friction Metals—			
"White Ant" brand ..	per ton	£42 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7¾d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4⅛d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£26 15	..

Quotations supplied by:—*a* Messrs. G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Messrs. Thos. Bolton & Sons., Ltd.; *d* Messrs. F. Wiggins & Sons.; *e* Messrs. Frederick Smith & Co.: *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* Messrs. James & Shakspeare; *h* Messrs. Edward Tull & Co.; *i* Messrs. Bolling and Lowe; *j* Messrs. W. H. Hindley & Co.; *k* Messrs. Morris Ashby, Ltd.; *m* Messrs. W. T. Glover & Co., Ltd.; *n* Messrs. P. Ormiston & Sons; *o* Messrs. Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
Aberdeen	May 9	960	+21	46,839	+12,115	—	—
Birmingham	,, 9	4,976	+254	98,502	+ 5,222	—	—
Bournemouth	,, 6	925	—	5,328	—	—	—
Blackburn	,, 8	724	+ 20	5,383	+ 604	12½	+1½
Blackpool and Fleetwood	,, 9	262	— 69	4,879	+ 301	7¾	—
Bolton	,, 10	1,610	+ 99	10,517	+ 1,744	25	—
Bradford	,, 10	3,167	+314	20,354	+ 1,973	39	+2
Bristol	,, 8	4,517	+411	—	—	28	—
Burnley	,, 9	733	+ 66	—	—	—	—
British Elec. Trac. Co.:—							
Barnsley District ..	,, 1	171	—	2,892	—	—	—
Devonport	,, 1	419	+ 36	6,934	+ 213	5	—
Dudley—Stourbridge..	,, 1	716	+ 86	12,623	+ 1,205	18½	—
Gateshead	,, 1	815	+133	14,148	+ 2,984	10½	+ ¾
Gravesend—Northfleet	,, 1	192	—	3,224	—	3½	—
Greenock—Pt. Glasgow	,, 1	554	+ 37	7,630	+ 595	7½	—
Hartlepool	,, 1	230	— 3	3,902	+ 471	6½	+2
Kidderminster	,, 1	108	+ 2	1,831	+ 105	4½	—
Merthyr	,, 1	175	— 26	3,152	— 180	3	—
Middleton	,, 1	316	+ 35	4,503	+ 153	8½	—
Oldham—Ashton ..	,, 1	558	+ 44	9,268	+ 1,039	8	—
Peterborough	,, 1	130	—	1,949	—	—	—
Poole	,, 1	261	+ 6	4,329	+ 710	3½	—
Potteries	,, 1	1,581	+ 56	26,117	+ 2,051	28½	—
Rotherham	,, 1	86	+ 41	1,086	+ 444	—	—
Sheerness	Apr. 29	73	—	372	—	—	—

* Compared with the corresponding period of 1902.

Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
B.E.T. Co. (*continued*)—							
Southport	May 1	319	+ 91	4,226	+ 1,966	5½	—
South Staffordshire ..	,, 1	818	+ 80	12,876	+ 122	21½	—½
Swansea	,, 1	452	+ 28	7,828	+ 630	5½	—
Taunton	,, 1	58	+ 1	908	— 53	1½	+1½
Tynemouth	,, 1	280	+ 11	3,960	+ 479	5½	—
Weston-super-Mare..	Apr. 29	70	—	654	—	2½	+2½
Wolverhampton Dist.	May 1	365	+191	6,213	+ 3,543	10½	+8
Wrexham	,, 1	124	—	608	—	—	—
Yorks. Woollen Dist..	,, 1	358	—	2,213	—	6	—
Cardiff	Apr. 25	1,689	+955	6,587	+ 4,025	—	—
Dover	May 9	207	+ 24	3,455	+ 84	3	—
Dublin	,, 8	4,759	+282	80,442	+ 4,133	46	—
East Ham	,, 9	568	+168	3,498	+ 1,177	5	+ ½
Glasgow	,, 2	13,180	+1494	593,567	+27,842	64	+12
Isle of Thanet	,, 9	410	+ 6	6,057	— 615	—	—
Leeds	,, 9	4,666	+190	33,073	+ 2,768	—	—
Liverpool	,, 2	9,870	+550	169,857	+ 8,834	101	+5
Manchester	,, 3	11,667	—	—	—	110	—
Newcastle	,, 9	3,114	+550	—	—	17	—
Portsmouth	,, 9	1,487	+206	—	—	29	—
Salford	,, 4	3,114	+887	16,301	+ 5,946	—	—
Sunderland	,, 10	1,027	+ 33	6 353	+ 304	20	—
Central London Railway	,, 9	6,962	—126	132,770	+ 5,882	6	—
City and S. London Ry.	,, 10	3,002	— 48	59,791	+ 3,286	6½	+½
Liverpool Overhead Ry.	,, 10	1,575	+156	29,416	+ 2,769	6½	—

LEGAL.

Kidd v. The Charing Cross and Strand Electricity Supply Corporation.

This case came before a Divisional Court of King's Bench composed of the Lord Chief Justice and Justices Wills and Channell on Wednesday last week, on the application of defendants asking for judgment or a new trial on appeal from a verdict and judgment entered at the trial before the County Court Judge of Westminster and a jury.

Mr. Longstaffe, in opening the appeal, said the action was brought by the plaintiff under the Employers' Liability Act for damages for personal injuries sustained by the plaintiff while in the defendants' employ, and in the Court below a verdict was passed for the plaintiff of £150, for which amount judgment was entered. The facts were these: The plaintiff was a fitter and jointer—that was to say, a highly skilled electrical mechanic—and early on the morning of September 9th a fire broke out from some cause unknown, at one of the junction boxes belonging to the defendants which was at the corner of the Haymarket and Panton Street. The next box going eastward, following the line of the cable, was at the corner of Oxenden Street. The fire which had broken out at the Haymarket box caused gas to be generated by the covering of the cable, and this had forced up the roadway, about halfway down the street. While the fire was raging, a man in the employment of the defendants, named Dirston, who was not a skilled workman, but a navvy foreman, called upon two other employés of the defendants, and also upon the plaintiff, to follow him to Panton Street and to bring their tools with them. When they got there somebody said something about the necessity of some disconnection being made, as otherwise the fire would spread. Dirston then appeared to have said that there must be a disconnection made at once at the east corner of the theatre. Plaintiff remonstrated, but Dirston said it must be made. Plaintiff thereupon put his india-rubber mat on the ground, and made the disconnection, knowing that the moment he disconnected, an arc would follow; this occurred, and he was blown across the street and his hand injured. It was urged on behalf of the plaintiff, first, that the box was of defective construction, viz., that it was not properly ventilated so as to allow the gas to escape. The jury found everything against defendants. The box in question was known among electricians as a "B. I. W." box, and was universally used throughout the country. The jury found, in answer to specific questions left to them, that there was a defect in the plant—in the ventilation of the box, and the plugging of the spare ways; that the defect arose, and had not been discovered, owing to the negligence of the defendants; that the plaintiff was bound to conform to the orders of Dirston; that Dirston was negligent; that the plaintiff, by reasonable care, could have avoided the accident, but that if he had taken such care, he would have been discharged if there had been further explosions; and having regard to the emergency that the plaintiff was not negligent in obeying the order of Dirston. The learned counsel submitted that there was no evidence on which the jury could properly find against the defendants on the first four questions left to them.

Mr. Collin (with him Mr. O'Sullivan) for respondent, said that the defendants in their notice of motion, had not set out that there was no evidence of bad ventilation or defective spare ways, or that Dirston was not the foreman.

Mr. Longstaffe said that the second motion before the Court was from the County Court judge's refusal to grant a new trial.

Mr. Collin: The sole reason in this notice of motion, is that the judge was wrong in law in giving judgment for the plaintiff on the ground that the judge should not have left the last question to the jury.

Mr. Longstaffe submitted that on the answer of the jury as to the contributory negligence of the plaintiff, he was entitled to judgment. Dirston was a man who had no mechanical or electrical knowledge at all.

Mr. Justice Channell: Was it contributory negligence to incur a particular danger in order to prevent a great danger?

Mr. Longstaffe submitted it was in the circumstances of the present case; Dirston had really no authority to give the order.

Mr. Collin said that that point was not raised in the notice of motion.

The Lord Chief Justice said the evidence was that Dirston was in sole charge of the work in St. Martin's Lane at that date. In those circumstances they could not say there was no evidence.

Mr. Justice Channell said that the authority of Dirston to give directions arose out of the circumstances. Nobody else was there above them.

Mr. Longstaffe said that Dirston was not above the plaintiff.

The Lord Chief Justice: It is no good you saying that in the face of the evidence given.

Mr. Longstaffe remarked that plaintiff's wages were much higher than those of Dirston.

The Lord Chief Justice replied that that had nothing to do with it.

In the result their Lordships, without calling upon counsel for the respondent, held that there was evidence to go to the jury, and dismissed the appeal with costs.

British Thomson-Houston Co. Ltd., v. The Mayor and Corporation of Manchester.

(*Continued from page 777.*)

Mr. Fletcher Moulton, in opening the plaintiffs' case, said the action was brought for infringement of letters patent No. 6,063A of 1889 in respect of an invention of Prof. Elihu Thomson which was communicated from abroad. They related to an apparatus invented by Prof. Elihu Thomson for the purpose of preventing the formation—or perhaps he should say for extinguishing, if found—an arc when the circuit carrying an electric current—especially a heavy electric current—was broken. When you broke a circuit containing an electric current, or suddenly made a gap in an imperfect switch, there was a bright flash or arc formed. A powerful current could not be interrupted without there being a great tendency for it to bridge across the distance by an arc. They were then dealing with the heavy currents used at that time in electrical engineering, when this matter became a source of great danger. In order to explain the device by which Prof. Thomson got rid of the danger, he (counsel) ought to explain to his Lordship from an electrical point of view what an arc was. Whatever might be the exact mechanism by which nature conveyed the electricity across a gap—a gaseous gap from solid conductor to solid conductor—its behaviour would be caused by its being conveyed by a series of extremely hot particles of gas forming the bridge across from one to another. Although, personally, he should be sorry to say that that really did describe the mechanism, it certainly did sufficiently describe it, to account for the behaviour. Therefore he might assume for the purposes of this case that that was the means by which it was conveyed across. You therefore had in the spark, or in the arc, he should say—the difference between the spark and an arc was that an arc was a continuous sequence of sparks of incredible frequency—a constant stream going along a conductor, not rigid or solid at all, but formed by the heated particles of the gas itself. It was Prof. Elihu Thomson who for the purpose of the promotion of the formation of an arc formed what was known as a "magnetic blow-out." It was well known at that time that a current passing through a conductor in a magnetic field was operated upon by the lines of maghet force in that field, and that the tendency was to move the conductor which carried the current in a certain direction. It occurred to Prof. Thomson that if this break was made in a magnetic field, then if an arc did form, what he had got was a current passing in an infinitely flexible conductor through the magnetic field, and he knew that that would be operated upon by the magnetic field and moved in a certain direction. He saw that by so doing what you could do was this, you could move it so that the path would be lengthened, so that the difficulty of the arc maintaining itself would be increased. The tendency of the arc was to move up and then snap. That was an extremely ingenious invention, and it had turned out to be an extremely useful one, because the application of electricity to engineering which employed large current had gone on very rapidly during the last 15 or 20 years. The consequence was that a number of cases with which they had to exercise this instantaneous command over the currents was multiplying enormously, but most of all in connection with electric traction. The reason was that in order to control the motors for electric traction, it was necessary to have the power of altering their internal organism according as they were starting, accelerating, running at full speed, slowing or stopping. It was not only in slowing or stopping that they wanted it. They wanted the motor to have a different construction at almost every different stage of its useful work. They did not by the construction of the motor fix permanently the arrangement of the coils. They fixed the coils, but they did not fix the electric arrangement. They made the coils of the motor in parts—a group of coils instead of one—and they brought the terminals of these coils to an apparatus of switches by which they could connect them at one moment in one way and at another moment in another. Proceeding, the learned counsel said the method of controlling motors by the series-parallel method had made the motor a serviceable and adaptable piece of mechanism, and he should scarcely be exaggerating if he were to say it was universally adopted. Perhaps that would be too strong language for describing any form of electrical mechanism, but his Lordship might take it that this method of construction giving the control was used in 95 per cent. of the bigger installations of electric traction. Of course, a system like that which suddenly changed the path of the currents of electricity through a motor necessitated the perpetual breaking of contact, and therefore something which would free this rapid breaking and changes of path from all danger was a necessity. Various methods to do this had been tried. There had been a sudden pneumatic blow, which by pouring cold air in a stream on this hot flexible conductor deviated the path and lengthened the arc, then broke it and blew it out. The one which was by far the most universally used was the modification of Prof. Thomson's magnetic blow-out. It was necessary to refer to two of Prof. Thomson's earlier patents to show the steps in the invention. No. 283,167, of 1883, was an American patent. Fig. 5 was what he believed to be the first form of magnetic blow-out. There was a horse-shoe magnet, and underneath to the left was a piece marked G, which was one of the terminals of the current. Immediately to the right of that was the switch arm H, which was the other terminal of the current. Supposing the current broke. If an arc sprang across from the nearest point of G to the nearest point of H, they would get a hot flexible conductor going in a horizontal direction from left to right. The magnetic field would have its lines of force there; and without troubling his Lordship with the rule by which electricians determined the direction in which the conductor was moved, he might say that in this case it would be moved upwards or downwards, according to the direction of the current. If it were moved upwards it would be lengthened, and ultimately would snap by reason of its being lengthened. That was the first and crude form, but great difficulties arose, because an arc was a very erratic thing. An electric spark was very unstable in its direction, and darted about in a most awkward way. They could not be certain at all times that it would go uniformly. Prof. Thomson certainly combined the very highest scientific ability

with great practical inventive power, and to him they owed a great debt in connection with electric invention in recent times. The professor set to work to improve this crude idea, and his next form was that shown in his American patent 321,464 of 1885. There was a great danger of the arc striking across, especially as they had the magnet with its metal so close, and what Prof. Thomson wanted was to remove that danger as far as possible. Therefore, he devised what was to be seen in fig. 2. It was an ingenious way of leading the arc out of temptation. There were two things which looked like horns—A was the left-hand one, and E the right-hand one. Those were the shaped terminals between which the break was going to be made and the arc formed, if an arc formed at all. Just underneath that was a magnet, and that magnet was so energised that the influence of the magnetic field would be to push the flexible conductor upwards. The arc would first form where those were nearest together—that is, just at the bottom. Availing itself also of the tendency of the hot air to rise, the magnetic field pushed the arc upwards, and in doing so it not only brought it up, but it drove the points from which it took its leap along the two curved horns, so as to be further and further from one another. In that way it very effectively lengthened the arc, and caused the arc to break. The chief use of this was not for actually breaking the current, but for what was called the lightning arrester. For instance, on wires used on the overhead tramway system to prevent lightning which struck the wires from getting into the machinery, this device was inserted in a suitable position, and the machinery would be protected. This form was very useful for the purpose, but it was a very unsuitable form for compact machinery, and the real demand for these magnetic blow-outs, was in connection with compact machinery, such as motors of electric cars. Prof. Thomson set to work to consider how he could best satisfy that want. In this case he adopted a type whereby he could tempt the arc to run into a position in which it itself increased the difficulty of passage by taking a long jump. It occurred to him that he would guide his arc so that there should be no danger of its taking the wrong course, and at the same time enable him to produce as powerful a field as he liked for the purpose of operating on the flexible conductor and breaking the arc. He thought of the idea of letting the arc be made between two insulated shields, and in that case he could bring his magnets as close as he wished to the place where the arc was going to make its appearance. This would give him absolute control of the intensity of the field. The intensity of the field of a magnet rapidly decreased as they got a distance from the strongest point. By taking the arc between the insulated walls he was able to bring his magnet closer to it, and therefore produced as strong a field as he liked to operate on the arc. He had another advantage. He was able to make the shape of his magnet just as he wished in order that this field might be the most efficacious. He freed himself from the danger of the arc going wrong by placing flat pole-pieces just opposite to one another and close together—a form which concentrated the field in such a way as most effectively to lengthen the arc and produce its breaking. He had devised a form of the utmost use. The learned counsel proceeded to read the amended complete specification of Henry Harry Lake, No. 6,063A, of 1889, during the course of which, in answer to a question from his Lordship,

Mr. Cripps stated that the main defence relied upon was want of subject matter.

Mr. Moulton said he presumed that the defendants would not contest the question of infringement.

Mr. Cripps said he could not say at that stage whether defendants would admit infringement, but he would be in a position to inform the Court after hearing the evidence of plaintiffs' witnesses.

Mr. Moulton, concluding, submitted with regard to subject matter that the original inventor of the device got a perfect freedom for choosing its field, its intensity, its position, and therefore controlling its effect. He did it by a novel device, which counsel submitted possessed every attribute of invention, novelty, and utility; and was designed to accomplish the thing for which it was needed. In these circumstances, and thinking as he did that there was no real issue here on infringement, he submitted the plaintiffs were entitled to succeed.

Prof. James Alfred Ewing, examined by Mr. Bousfield, said he was Professor of Engineering at the University of Cambridge, and had taken an appointment at the Admiralty, which he was sorry to say would prevent him being seen in Court in future. He had gone very carefully into this specification and apparatus which were the subject of the present action. The fact that an arc might be deflected had been long known, and was first discovered by Davy. The first practical application of it was by Elihu Thomson in the specification No. 283,167 of 1883 of the United States. The application was to blow out an electric arc when that arc was liable to form on the rupture of an electric circuit. In several of the practical applications of the electric circuit it was necessary from time to time to suddenly interrupt the circuit by withdrawing the two parts of what had previously been a continuous conductor. When that was done, a spark occurred across the gap so formed, and under certain conditions that gap might persist as the arc crossed the gap, thereby frustrating the intention, which was to replace the circuit, and also leading to the damage of the two electrodes in consequence of burning by the arc. Various devices had been used for blowing out the arc formed under these conditions; and this device of Thomson's was the practical application of the principle that a magnetic field was capable of so far deflecting the arc as to lengthen it to the point of rupture. He applied it in this patent to various practical cases where an arc was liable to be formed. In fig. 5 of this patent there was shown an ordinary switch whereby movement of a rotating handle, H, away from a block, G, the electric current was interrupted. When H was moved away from G an arc was liable to be formed between the two, and this was blown out by the proximity of a magnet, M, which might be either a permanent magnet or an electro-magnet. M was represented as a horseshoe, and the lines of the magnetic force went directly across from one to the other pole of the horseshoe. The direction in which it was blown out depended on the relation of the poles to the direction of the electric current. The subject of Thomson's patent of 32,146 was the next practical application in reference to lightning arresters. The lightning arrester was a device which should automatically discharge to earth—the electric circuit when that had been raised to an excessively high potential by the action of atmospheric electricity. In order to make this discharge, it was necessary that there should be a temporary, a very temporary, connection with earth, and that they should avoid anything in the nature of a permanent connection with earth, because that would interfere with the ordinary work of the electric circuit. Referring to the plaintiffs' specification, witness stated that the title of the patent was "electric sparking rupture appliances," and there was in the picture shown apparatus both for lightning arresters and for other cases where it was required to rupture the spark—lightning arresters, safety fuses, electric switches and devices generally. From an electrical point of view, it seemed to him that Thomson, the inventor, recognised the capricious nature of the arc. He recognised that, although such shapes of magnet poles as he had shown in his previous specification would apply satisfactorily, still, every now and then it happened that, owing to some capricious movement of the arc previous to its rupture, there was a liability to an accident occurring—namely, the arc striking the conducting surfaces of the magnet pole and thereby preventing the device from accomplishing its object, and that this was especially liable to happen when he approached the magnet poles near to the arc, as he would do for the purpose of securing the action of a strong field upon the arc. There was a double advantage, from a scientific point of view, in bringing the magnetic poles close to the place where the arc was liable to be formed, but there was, first of all, the advantage that, pole to pole, they got a stronger effect by bringing the poles nearer. Secondly, there was the advantage that, if you constituted the magnet in the form of a narrow trench or gap between two poles, you got a much stronger magnet *qua* magnet. You got a stronger magnet by making the magnet in the form where there was a merely narrow space between two poles. The poles became individually stronger, and besides that by bringing the poles close up to the electrodes, you got a stronger pole. That was a matter of importance. They got a much more powerful field with these devices than had been got before.

Mr. Bousfield: It has been suggested that owing to what Prof. Thomson did in his first specification, and in his second specification, there was nothing left for him to invent in passing on to his third specification. What do you say as to that?—I do not agree with that at all. Prof. Thomson was an extremely clever electrician, and it is clear to me on reading his second specification, that he really had a new idea in it. To my mind, there is no doubt whatever about there being substantial invention in this last invention. He had altered entirely the form of his magnets in consequence of his introducing a new element into the combination which had made that alteration possible.

In your view is his third patent a distinct step in the evolution of the thing?—A very distinct step.

And for the purpose of applying it in many of the ways in which it is applied nowadays, was it a necessary step in the evolution?—Yes. In answer to further questions, witness said he thought defendants had clearly infringed plaintiffs' patent.

Cross-examined by Mr. Cripps: He had studied the specification on which the action was brought.

Do you find anything in that claim except that the insulating material is to be put at a particular place?—It is mentioned in a particular place. Yes. It is the introduction, as I say, of a new element into the combination.

Do you find any claim there except the introduction of an insulating material in the condition stated?—No.

That is all you find?—In the condition stated. I should say it is not simply and only the introduction, but the introduction for a purpose which is claimed.

Of course, purely for a purpose. I am not suggesting it is purposeless. But it is the introduction for a stated purpose. The claim, I think, relates to the purpose as well as to the introduction. It was known in 1889 that the influence of the magnetic field on the arc rupture power was increased by its proximity to the arc which it was being sought to rupture. The risk of arcing was greater the higher the tension of current. The claim in the plaintiffs' specification was for a shield of insulating material located between the surfaces of the electrodes and adjacent conducting surface. A device by which the arc was disrupted.—It is nothing more than putting a shield of insulating material so as to prevent the arc forming between the electrode and the magnet.

Doing that in a particular device and for a particular purpose?—Yes.

The purpose described really means to prevent an arc forming between the electrode and the magnet?—I think a little more than that.

What more does it mean than that. Keep to the claim and not the invention mind?—Thereby permitting the arc-rupturing device.

What is the novelty?—The novelty is the introduction of a new element.

What is the new element?—The new element is the insulating material—the septum.

Do you say that the introduction of insulation between two surfaces where you do not want electricity to pass is a novelty?—For a particular device, yes. I am speaking of the claim, of course.

It is clear that apart from the mere question of insulation, and looking at these prior patents of Thomson, we could have used our

device subject to the question of whether we could use the insulating material or not?—I do not know whether there are any other patents covering that.

Do you mean to say there is any invention whatever in putting in an insulating material when you want to prevent the spark going to the magnet?—It would be impossible to get the magnet in that form without the insulator. Witness said his point was that the introduction of the insulating material made that form practicable.

Take fig. 6, could anyone put a septum or insulating material between the magnet and the electrode. Do you mean to say he could not do that?—So far as I can judge, there would be a case of infringement against him.

Re-examined by Mr. MOULTON: Looking at the history of Thomson's invention, starting from his first 1883 patent, Witness thought that the patent in question pointed to the solution of difficulties or something that would help to meet the improved type.

Mr. JOHN GRAY was next called. Examined by Mr. WALTER, he said he was in the employment of the plaintiffs.

With reference to the user of the third invention in this country, I want to ask a question first as regards switches and so on in stationary work.

Mr. CRIPPS: That is not denied.

Mr. WALTER: Is the use small or large?—WITNESS: Very large.

This being the plaintiffs' case, Mr. CRIPPS said he would call the witnesses for the defence before addressing his Lordship.

Lord KELVIN, examined by Mr. CRIPPS, said he had studied the specifications and claim on which the action was brought. He agreed with Prof. Ewing that it was well known that an arc could be ruptured under the influence of the magnetic field, and also that the magnetic field could be supplied either by a permanent magnet or by an electro-magnet. It was known also that the influence of the magnetic field in its power to rupture the arc was increased by its proximity to the arc to be ruptured.

Would that influence in any way have been altered by putting an insulating shield between the magnet and the arc to be ruptured?—No; not at all. It was well known.

Was it known that, apart from any insulating material, there would be a tendency for the electricity to go from the electrodes to the magnet in proportions so as to draw the magnet nearer to the electrode?—Yes; the current is always liable to pass out of the electrode, and is, in fact, kept in the electrode by the electric resistance of air in ordinary circumstances when no solid insulator is interposed. In his view there was nothing in the nature of invention or novelty in putting the insulating shield between the electrode and the magnet. It was common knowledge that a shield of any proper material would serve to prevent the electric current from passing from the one surface to the other.

Take the American patent of Thomson, No. 483,167. In fig. 1 do you have there the magnet in proximity with the electrode?—As close proximity as possible to the electrodes and two places where an arc would form if an arc was to be formed.

I do not want to take you into any detail unnecessary. From any particular figure in Abel's, or from anything you find in Thomson's earlier specification, do you find that insulation under the conditions in the patent sued upon is matter of common knowledge and common practice?—Certainly.

There is neither novelty or invention?—No.

(To be continued.)

The hearing was concluded on Monday, and judgment was delivered on Wednesday. The action was dismissed with costs.

FOOTE & MILNE *v.* ST. HELENS CABLE CO., LTD.

(*Continued from page 777.*)

BEFORE Official Referee W. Verey, on May 5th, the hearing of this case was resumed.

The earlier five days' hearing appeared in our issue of May 8th, 1903, and it will be remembered that in this case the plaintiffs sued the defendants for expenses incurred, and damages sustained to reputation, due to alleged defective cables supplied to them by the latter. The last witness on the 4th inst. was Mr. H. C. Silver, of Faraday House, who had tested cables sent him by the defendants.

Mr. H. C. SILVER, cross-examined, said he had not examined the cable for injuries. His tests had been upon the cable supplied to him for the insulation resistance of the dielectric. In reply to the question as to the number of tests of cables he made in the course of the year, Mr. Silver stated that he could not give an exact figure. Asked how many tests he had made of any cable in 1903, he thought about a couple of dozen would be near the amount. Of course, he had had other work to do. His tests on the cable in question had been made by means of a Kelvin galvanometer, a universal shunt, and two dry cells in series in some cases.

Mr. TERRELL at this point discovered what he termed "a curious coincidence," and he asked the witness how he could explain the fact that whenever the two dry cells in series was used he got bad results, whereas when electrifying the cables from the main was resorted to the results were generally extremely good.

WITNESS pointed out that the explanation was so simple as to appear somewhat obvious. The insulation resistance on some of the coils was so defective from some cause or another that the deflection was too great with the current from a battery or the main, and consequently it was upon these coils, and these only, that the dry cells in series were used. He did notice that these coils were very good or very bad. He could not say anything about what might have produced the great difference, nor was he disposed to offer any suggestion. He was here to speak to his report of the tests.

A dispute between counsel arose at this point, and since it may have bearing upon the value of the tests, as tests on certain specified cable, it may be well to state that apparently no one coil in particular could be identified to its corresponding manufacturer's label. It apparently was scarcely disputed that the coils tested were of St. Helens Co.'s make, and plaintiffs' counsel stated that while he could not compare the tests made at Faraday House against the test stated on any particular label, yet the coils could certainly be divided into classes, and the average of tests of each class be compared.

WITNESS admitted that the rubber insulation in the bad tests was practically of no service.

Re-examined, WITNESS said that of course he was occupied with other tests as well as those upon cables. The low insulation might be caused by the use of poor material in the insulation as well as by injury to it.

(Some time was occupied in a dispute between counsel as to the further tests and examination of these coils still lying at Faraday House. Mr. Terrell asserted his right to go there alone or with experts, and make his own examination or tests. Plaintiffs' counsel disputed his right. It had been open to him, and he had been invited, in fact, had taken out an order, to view and test these cables many months previously. He had not done so, and it was not just that he, at this late date, should now claim the right to go alone and make what tests he pleased. He was willing that the coils should still be examined and tested by Mr. Terrell and his experts, on condition that theirs should be there also, and that these tests should not be allowed to delay proceedings. The Referee thought that this was as much as Mr. Terrell could ask. The offer was not accepted, however.)

Mr. A. R. DOLBY, consulting electrical engineer, the next witness, stated that he had been adviser to Mr. Percy Adams, architect of the Belgrave Hospital, and had looked after the carrying out of his specification for the electric lighting. (Belgrave Hospital is one of the jobs wired with defendants' cable, which had to be re-wired.) He had been satisfied with the workmanship, tubes and fittings. Certain tests were specified to be obtained after the wiring, but these were not got, and he attributed this to bad insulation of the cable. He had insisted upon the job being re-wired, and had agreed to give the St. Helens cable another chance. Some of the new wire was found unsatisfactory, and he on January 28th, 1902, refused to have the St. Helens Cable Co.'s wire used at all. The building was re-wired with Henley cable, in the same manner, and proved satisfactory. He was not going to risk his reputation by leaving the St. Helens wire in.

On cross-examination, Mr. DOLBY proved a very determined witness. As regards what he had specified for, he stated again and again that what he specified and what he wanted was a cable giving not less than 600 megohms per mile. He had mentioned Silvertown's Class S for smaller sizes, and Class K for larger sizes. Witness was then taken through a series of questions to show that what he had stipulated for was very different to what plaintiffs had supplied him with. Mr. Dolby held to his point, however, that what he wanted was 600 megohms per mile minimum insulation resistance. Had the cable been good there would have been no question, for it would have given true the test he required. He had made no tests on the first wiring personally. He had depended upon the contractors' tests. Since they proved so low there was no reason why he should go to the trouble of testing what was clearly an unsatisfactory installation. He might have got, he admitted, a circuit or two good, but he re-stated emphatically that this would not have given him any reason for allowing any wire to remain of a similar make to what had proved in the main to be so unsatisfactory. As for makers' warranty labels, he had found this maker's labels to be unreliable.

Mr. TERRELL: You are speaking now from tests made by other people—the contractors?—Yes. As regards guaranteed insulation on cables, he did not consider that in practical work these meant a great deal. Comparing the insulation got between poles with all lamps, switches and fittings on, witness asked what relation had that test to the 600 megohms in the specification. He did not think 300-grade cable was so good as 600-grade cable, but he could not say anything about grades.

Re-examined, WITNESS said he was absolutely astounded at the fact that any manufacturer should put such warranty labels on wires, which on testing gave such different results. If he might be permitted the expression, it was an eye opener to him, and had considerably shaken his confidence.

Mr. P. F. W. ABBOTT, storekeeper to Messrs. Foote & Milne, was then called. He stated that he had charge of the inward and outward book. He remembered the occasion when all the cable in stock was returned to the St. Helens Cable Co. Holmes, the storekeeper for the defendants, had sorted out his own make, and had signed the statement put into Court.

Cross-examined, WITNESS stated that he could tell the St. Helens cable from Frankenburg cable. He was told to send back St. Helens only. He would be greatly surprised to learn that wire other than the St. Helens was sent back to them.

Mr. FOOTE, partner of the firm Foote & Milne, was the next witness. He stated that it was in February, 1900, that they first began to trade with the defendants. They never ordered the wire by grade, as could be seen from their orders, which ran, quantity size, colour, class (the latter depending upon tape and braid). In the interview with Mr. Heyl-Dia, the latter had stated that some bad coils might possibly have slipped through without being tested. He had shown Mr. Heyl-Dia some of his make of wire, which had a knife edge. The sample was carried off by him as a "curiosity." In the interview all the jobs in question had been discussed, and the damage to their reputation had been insisted on. He had raised no doubt about how they must suffer. As for the sample of cable shown (without rubber), which it was stated had been sent to them by defendants, he could not say how this, if it had happened, had occurred. They had never had cable of this sort in

use. His only suggestion was that it might have come from defendants. It was of foreign make, and he knew that at first they had sold foreign cable. His duty in the firm was principally connected with the financial matters. The costs books were kept in the greatest detail. Of the wire used for the Liverpool job, £1,201 worth, was sent direct from Warrington to Liverpool. £83 worth of St. Helens make, and £169 worth of Frankenburg's from the store. £166 worth of cable was returned from Liverpool, making the cost of the cable used £1,288. When the question of re-wiring arose, he had gone down to see Mr. Lyster, but the latter adhered to his decision that all the wiring must be removed. The total cost of the re-wiring at the Tobacco Warehouse was £2,311 18s. 6d. Mr. Foote was then taken through the various figures, given in the first day's hearing. Modifications rendered necessary by minor details were agreed upon, reducing the total claim for expenses for re-wiring all the jobs, to £2,675 11s. 5d. In regard to the general claim for damage to reputation, he considered that their business had suffered. They were no longer asked to tender for Mersey Dock and Harbour Board work.

Cross-examined by Mr. Terrell, Witness said that the inducement to trade with the St. Helens Cable Co. was the reasonable price of their cable. There were plenty of people who were selling as cheap as the St. Helens Cable Co. outside of the Ring. He had never bought cable by the grade, and if he had referred to it by the grade in a letter or two, it was accidental, as on the orders it would be found that no grade was mentioned. He couldn't really say what was meant by 300-megohm grade. Shown the Silvertown list, he still adhered to his answer that he did not order by grade. He looked at the warranty figures of the insulation resistance. There was no guarantee of durability. Since the case came on he had asked Henley to guarantee 300-grade cable, Mr. Potter had given his reply to Mr. Milne who could be recalled. He had not dreamed of testing the cable before using it. It had never been necessary before, and in the future they would see that it was unnecessary again by only buying from the best makers. Frankenburg cable was really cheaper than the St. Helens, but they had had a dispute with Frankenburg and did not desire to buy from them. He would explain if necessary, but would rather not be asked.

Re-examined, Mr. Foote stated in connection with a guarantee for the durability of a cable, that the question which had been asked Mr. Potter, of Henleys, was, "What, as an ordinary commercial matter, they could say as to a guarantee on their 300-grade cable." Mr. Potter had replied that he had discussed the matter with his works, and that he could definitely guarantee that the insulation resistance of their 300-grade cable would not fall more than 10 per cent. in six months, and would probably be better than that. He could give no better guarantee for their 600-grade cable, as the ratio of the fall of the two was practically identical. As to anything further, he would have again to consult the works manager.

Cross-examined, Witness held to his statement as regards grades of cable. As for leaving the wire other than St. Helens in the tubes, it would have cost more to search for it than it was worth. He might have tested each separate circuit and tried to deduce from that where the good wire was, but this would not have helped matters. It would have taken much longer than three days to have done these tests.

On May 6th the Court opened with Mr. Foote in the box, under cross-examination. St. Helens cables had been used in other jobs which they had been able to get passed. As for sending other manufacturers' cable back to St. Helens, while it was possible, it was very unlikely. There was no advantage to them in doing so. They had asked for its return, but none had been sent back.

In his re-examination, Mr Foote was taken through some of the charges in dispute, which amounted to £46. It was agreed to half this, and the pulled-out cable at Liverpool to be assessed at a scrap value of £60.

George Lee, one of the wiremen of the plaintiffs, gave evidence with regard to coils sent to Faraday House from Belgrave Hospital. These were new and unused. He had attached his signature to the labels. In cross-examination, he stated that he had no means of identifying any particular coil.

Mr. Hamilton, K.C.: That is my case, sir.

Mr. Terrell, K.C., said: The defendants are makers of cables, and, like other manufacturers, they divide their cable into grades, and these grades denote the quality of the electrical insulation. The insulation does not differ greatly. The high figures of the resistance are accidental to a good quality of lasting insulation. The wire itself is the same. The insulation is always made of pure rubber mixed with pigments from 40 up to 80 per cent. It would be a waste of money to use pure rubber only; but the more rubber there is, the better are the lasting properties. A large percentage of pigment means a cable which will be more liable to absorb moisture, and one, therefore, which will be attacked quicker by moisture. Whilst a 300-megohm grade cable would be excellent, and last for years in a dry place, it would not be at all suitable for a damp place. The plaintiffs ought to have used a class of cable better able to resist moisture. Look at the contrast! It is alleged that we sold them cable able to be used for a 600-megohm resistance per mile. They bought 300-megohm grade wire! The Faraday House tests show that we supplied half the cable greatly above the warranty. The other half showed that they had suffered damage. The same wire was used, the same rubber, the same machinery, and the same tests. The Liverpool contract stipulated for an insulation resistance of 600 megohms per mile. The plaintiffs are suffering because they took this contract, and tried to do it a great deal cheaper than they ought. I shall ask you, sir, to say that it is very well understood what is meant by 600-megohm insulation resistance per mile. It means a cable which, with the very thickest wires used, will have an insulation resistance of 600 megohms. The contract includes thick and thin wires, and the 600 megohms is applied to them all. The grading is a division of rubber-covered wire insulated by different qualities of rubber insulation. The meaning of the term in the contract "600-megohm insulation resistance per mile" was that the insulation of the smaller sizes of wires must be made of the same quality of rubber as on the larger sizes used. The grading is a test of the quality of rubber for durability. Did they want the smaller sizes to have a less durability than the larger? The Faraday House tests are evidence in our favour. Coils sometimes get injured in handling or transit, and this would account for the bad tests due to local defects. Atlantic cables are subject to the same damage, and none are laid without, generally, 40 pieces being cut out. The Tobacco Warehouse was a cold, damp building, situated just at the water. 300-megohm grade cable ought never to have been put into it. 600 or 1,000-megohm grade wire ought to have been used. The attack upon us is, "You gave us bad cable." Every witness they produced was absolutely ignorant of cable-making, with one exception, and he was brought to identify samples only. I have put to them question after question with the same result. Not one of them is able to assist you in this matter. In these jobs the cheapest quality of cable, and the cheapest possible tubes were used, and we find them constantly complaining of the high cost of wages. These having produced the worst possible results, they come down on the cable-maker.

Mr. Wordingham, M.I.C.E., M.I.M.E., M.I.E.E., was the next witness, and stated that, in addition to the above qualifications, he had just been appointed consulting electrical engineer to the Admiralty. He was intimately acquainted with electrical cables and their insulation. The grade of cable signified the quality of rubber. The mention of megohms per mile meant reference to the actual insulation resistance of one of a few sizes. If the same thickness of rubber were applied to various thicknesses of wire, the smaller sizes would give a vastly greater insulation resistance than the class as a whole. The question of grade depended solely upon the thickness and quality of the rubber. A low-grade wire is more susceptible to damp than a high-grade wire. It affects it by penetrating into the insulating material and dissolving out the pigment, and so causing the covering to be porous, and necessarily destroying its insulating power. He had seen the tobacco warehouse in February, 1903. A 300-megohm grade wire was not fit for the job at all; the consequence of using it would be a breakdown, and he was not surprised that that should have occurred. Questioned with regard to the Faraday House tests, witness pointed out that, after all, a big job need only require an actual 20-megohm insulation resistance. A high insulation was a good test of a good rubber. The reason why a high insulation of rubber cables is desired is because it means greater durability of the cables. As regards the way in which the Faraday House tests were made, he did not know how they had been carried out as regards details. The ends of the coils ought to have the braiding carefully pared back for 3 in. The rubber should be cut with a clean knife. If the day was damp, it should be slightly warmed. If the test were then carried out, all would be correct, but should any delay take place, the ends of the wires should be coated with paraffin wax. The results in the report showed that some of the cables had a high insulation resistance. The bad tests indicate local defects, or that the ends were not properly prepared. If the wires had been roughly handled, local defects might have been produced. The tests, as a whole, showed that the insulating material was good, but that there were defects in individual coils. Such cables as the latter might, when installed, give a test which, high at first, might afterwards get low. The water test would show these at once. The factory test would have shown them at once had they been there. Assuming these points, the only conclusion would be that they had been damaged in transit.

In answer to the Referee: If they had not been damaged after leaving the factory, his conclusions would, of course, be the reverse. Continuing, the witness stated that he had never known cable-makers not to test their cables. Supposing these cables were tested *at all*, such faults as these must have been clearly shown. The other Faraday House tests brought him to the same conclusions, and he drew the same inferences. As regards Dr. Marchant's tests, he could only say that the tests of the first lot (Frankenburg cables) showed up with surprising uniformity. The coils that were low showed him that a local injury had taken place. The pulling out would certainly injure the rubber. Taking the tests as a whole, the only conclusion he could come to was that they gave no indication of the unused cable. Even with the greatest care, mechanical injury due to the pulling out would be very hard to remedy. With regard to portions of Robinson's letters, they pointed out that the plaintiffs were trying to use the smallest tubes possible for the sake of cheapness.

Cross-examined, Witness adhered to the statements he had made in his examination. The use of 300-megohm grade cable at the Liverpool job was unwise. He wouldn't use 300-megohm grade wire in steel tubes at all, and, further, would not use Simplex tubing, first, because it was not water-tight, and second, because the split was liable to be the cause of rough places. The 300 cable was liable to breakdown in presence of moisture. The insulation of a cable might fail through bad material and bad usage. After manufacture, the cable, before the braiding was put on, should be tested after 24 hours' immersion in water. Records would be kept of the larger sizes, at least. Perishing of the insulation would destroy its insulating properties. As regards Marchant's tests, they must have known that tests on cable which had been pulled out, were of no value as tests of the insulation before use. While Marchant, he knew, had done his best to eliminate mechanical injury, the tests only pointed out that such had occurred. A certain amount of force was required for withdrawal, and further, the old cable had to stand the extra strain of dragging in the new. He believed that

the Henley cable had tested low already. It would certainly have had a better chance, because the buildings would be less damp. A further cause of injury would be the fact that in pulling out, the copper would easily stretch sufficiently to overstretch the insulation. Uneven mixing of the rubber might cause bad insulation, but he thought this unlikely. As regards the Frankenburg cable not showing the same faults, though subjected to similar usage, he pointed out that Robinson had been instructed by his firm to take especial care of Frankenburg's cable, and that had a certain effect on his mind. The 600 cable breaking down would be due either to mechanical injury or to damp. He had known 2,500-grade cable fail in presence of damp. In a dry place the breakdown would be due either to bad manufacture or bad workmanship. If the damage was a clean cut, the moisture would take longer to penetrate it, and consequently a high test at first might be obtained. As regards the Faraday House test, witness pointed out that the temperature of the water was not given. This would make a considerable difference if it had not been allowed for. (Mr. Silver was afterwards re-called, and stated that the tests were made at the standard temperature, 60° F.) Witness then gave his opinion of Faraday House, in brief, a useful, profit-making institution. He was then taken over the various points in Robinson's letters, and was afterwards re-examined, nothing important being elicited.

Mr. Mervyn O'Gorman was then called, and gave evidence that he had examined the tobacco warehouse. He considered the use of 300-grade wire in such a place, improper, and was not surprised at the breakdown. He agreed with Mr. Wordingham as regards the meaning of the contract term "600 megohms per mile." He ridiculed the tests that had been made of the cable by Radcliffe in dry heat and steam heat. As regards the Faraday House and Marchant's tests, his evidence was similar to the last witness. He had manufactured rubber cables himself. The very best cable would have 50 per cent. of rubber, and 50 per cent. of pigment. Lower grades of cable contained more pigment until the rubber was perfectly gorged with it.

(To be continued.)

National Electric Traction Co.

In the King's Bench Division on 8th inst., Mr. Justice Phillimore heard an action brought by the Robinson Printing Co., Ltd., against the National Electric Traction Co., Ltd., and F. J. Bird, to recover £500 on a bill of exchange. The action was undefended. Judgment was entered against both defendants for the amount claimed, with interest and costs.

Johnson v. The Fleetwood and District Electric Light and Power Co., Ltd.

In the Chancery Division on Tuesday, before Mr. Justice Kekewich, Mr. Cann appeared on behalf of the plaintiff in this case, which came up on a motion for judgment in default of defence. Learned counsel said that a receiver had already been appointed in the action, which was brought by a debenture holder. His Lordship made the usual order in a debenture holder's action.

Chamberlain & Hookham v. Bradford Corporation.

The hearing of this appeal was continued in the House of Lords, and extended over several days. Their Lordships reserved judgment.

SOUTH AFRICAN NOTES.

(From our Special Correspondent at Johannesburg.)

April 20th, 1903.

Pietermaritzburg, Natal.—At the last meeting of the City Council the following proposals were made by the Electric Light and Tramways Committee:—

"That Messrs. Mordey & Dawbarn, of London, be appointed the consulting engineers for the Council in England, to attend to the purchase, testing, &c., of such materials for the electric tramways as may be obtained from England. This appointment will be in addition to the appointment of a resident consulting engineer.

"That the Park Oval, pavilion and grand stand in Pietermaritzburg be illuminated by means of arc and incandescent electric lights at a cost not exceeding £600.

"That in the extensions to the electricity works, the purchase of a steel chimney stack, lined with fire-brick, be included, to cost not more than £2,000."

All these resolutions were subsequently passed.

The *Times of Natal* recently published a comparison between the electric light systems of Pietermaritzburg and Durban, which purported to show that the charges made for power in the capital were nearly 2d. per unit less than in Durban. The *Natal Mercury* criticises this report and gives the following figures, from which it would appear that the Pietermaritzburg authorities have based their average on the total units generated, including the current consumed by the station, streets, loss in mains, &c., whereas at Durban they have based the revenue on the returns from private consumers only:—

The total units consumed by private customers at Durban for the year ending July, 1902, were	636,714
For the same period at Pietermaritzburg the total units generated were	624,794
The revenue at Durban being	£21,000
And that at Pietermaritzburg	£18,688

The charge at Durban is 8d. per unit, whilst the maximum demand system is in use in Pietermaritzburg and is thus difficult to bring to the same comparative base. The following, however, is an average taken during the same period:—

Business houses	8·1d. per unit.
Private "	8·7d. "
Churches	9·2d. "
Public offices	7·65d. "

These figures show the load in March last:—

	Pietermaritzburg.	Durban.
Number of consumers ...	719	1,674
Aggregate H.P. of motors ...	208	361
Arc lamps	91	190
Street incandescent lamps ...	28	530

Johannesburg—Pretoria Telephone Trunk Service.—The following particulars are given with regard to the newly instituted telephone service. Call offices are now, or will shortly be, opened at the following places:—Pretoria, head Post Office and Station Post Office; Johannesburg, head Post Office, Fraser Street, Fordsburg, Jeppestown, Commissioner and Troye Streets, Braamfontein, Rockey Street, Bree Street, Hospital Hill. The charges will be: To subscribers already connected with the service in either town the charge will be an additional £20 per annum, by which they can use the trunk line at any time, and can also use the district call-office telephones on production of a card of identification. To the public the various charges will be:—

1s.	for each three minutes for a distance of 5 miles.						
2s. 6d.	"	"	"	over 5	"	and under 30.	
3s.	"	"	"	" 30	"	"	50.
3s 6d.	"	"	"	" 50	"	"	70.

Aliwal North, C.C.—At a public meeting held this week it was unanimously decided to authorise the Town Council to levy an emergency rate of 2½d. in the £ in connection with the water and electric light scheme. A movement is on foot for the installation of a telephone service.

MUNICIPAL ELECTRICITY UNDERTAKINGS.

[BY A CONSULTING ENGINEER.]

It has frequently been prominently brought before my notice that the manner adopted by municipalities in drawing up the balance-sheets of their electricity undertakings is producing a very misleading effect throughout the country. Not only do the results as shown on a balance-sheet mislead other corporate bodies, but they often have the effect of deceiving the Corporation which has issued it, and of lulling it into a feeling of satisfaction and security altogether unjustified by the actual state of affairs.

In order not to be misunderstood, or lest it should be supposed that it is my intention to cast doubts upon such balance-sheets for any particular year, I proceed to give the reasons for my statements by showing that the only safe way of estimating the prosperity, or otherwise, of a municipal electricity undertaking is to take the balance-sheets for a period of about 10 years, and to see whether over that period the undertaking has been a profitable one.

It is not a simple matter to analyse the balance-sheet of a municipal electricity undertaking because, in many cases, the capital expenditure is not sufficiently sub-divided under proper headings, and a correct estimate of the amount which should be allowed for depreciation is almost an impossibility.

To illustrate my meaning, I give below an actual statement of the capital expenditure of one town, and in a parallel column the rate per cent. which, in my opinion, should at least be allowed in each case for depreciation.

	£	s.	d.	Least amount which should be allowed for depreciation.
Buildings	15,936	15	11	1 per cent.
Plant and machinery ...	31,335	13	5	7½ "
Mains	30,558	9	4	7½ "
Meters	4,220	13	1	10 "
Electrical instruments	458	13	9	5 "
Public lamps	9,959	8	7	2½ "
	£92,469	14	1	

Or an average depreciation of 5·94 per cent. on the whole plant.

To put this in a manner which will appeal more to our experience of the life of the various items, and to take the case most favourable to the municipalities, let us suppose

that the amount allowed for depreciation is regularly invested and bearing compound interest at the rate of 3½ per cent., then

1	per cent.	depreciation	allows	for a life of	44 yrs.
2½	„	„	„	„	25 yrs. and 6 mths.
5	„	„	„	„	15 yrs. and 6 mths.
7½	„	„	„	„	11 yrs. and 2 mths.
10	„	„	„	„	8 yrs. and 9 mths.

That is, we are assuming that at the very most the life of the buildings will not exceed 44 years, of the public lamps 25½ years, of the electrical instruments 15½ years, of the plant, machinery and mains 11 years 2 months, and of the meters 8 years and 9 months.

Anybody who has had experience of central station work will say that this depreciation is greatly underestimated, and yet on this basis I shall be able to show that there is scarcely a municipal electricity undertaking in the kingdom which is not losing money, although there are several which are deceiving themselves to such an extent that they are handing money over to the relief of the rates, when in the not far distant future they will have to increase their capital expenditure on the security of the rates. Referring to the case quoted above, the depreciation which should be allowed is given as follows :—

Buildings	£159 7 4
Plant and machinery	2,350 3 6
Mains	2,291 17 11
Meters	422 1 4
Electrical instruments	22 18 8
Public lamps	248 19 8
	£5,495 8 5

To set against this we find in the balance-sheet referred to :—

Distribution and public lamps ...	£1,513 9 4
Sinking fund	2,396 19 7
Reserve fund	700 0 0
	£4,610 8 11
Less balance from previous year's a/c	119 11 8
	£4,490 17 3

There is also an item of £810 13s. for repairs and maintenance in the generating station, but this cannot be set off against depreciation if only 7½ per cent. is allowed, because in spite of all repairs the plant is likely to be renewed almost in its entirety before the lapse of 11 years.

We thus see that the municipality to which this balance sheet refers is probably losing at the rate of £1,000 per annum, although the balance sheet ostensibly shows a substantial balance on the right side.

Following the same method of procedure, I have analysed the balance-sheets for the year ending March, 1902, of several municipal undertakings, and as the following table shows, they each and all foretell the same disastrous tale. Some, of course, are worse than others, but the ultimate result in each case will be a further call upon public money for additional capitalisation.

To still further elucidate and emphasise my remarks I add another table, comprising the same towns given in Table I., and showing the life which the plant as a whole must have in order that the amounts put aside in each case for depreciation may be sufficient on the assumption that as each amount is annually set aside it is invested at 3½ per cent.

Table II.

Town.	Percentage on capital outlay allowed or available for depreciation.	Number of years plant will have to last.
Accrington	2·810	23 years 7½ months.
Ashton-under-Lyne ...	3·220	21 „ 8 „
Barrow-in-Furness ...	2·660	24 „ 5½ „
Blackburn...	4·430	16 „ 11 „
Burton-on-Trent	2·147	28 „ 3 „
Carlisle	3·700	19 „ 5 „
Croydon	2·835	23 „ 5 „
Darlington	2·916	23 „ 0 „
Darwen	3·508	20 „ 2 „
Derby	3·197	21 „ 7 „
Dewsbury...	3·480	20 „ 3 „
Edinburgh	4·000	18 „ 3 „
Dudley	3·480	20 „ 3 „
Glasgow	3·234	21 „ 5 „
Gloucester	1·146	40 „ 7½ „
Manchester	3·400	20 „ 7½ „
Salford	2·800	23 „ 9 „
Southport...	3·260	21 „ 3 „
Torquay	2·280	26 „ 5 „

An examination of Table II. would almost lead us to suppose that we had reached the happy stage of finality in electrical progress, and that no further developments towards economising in the production of electrical energy were possible. The towns quoted in the table are on the average working on the assumption that their plants will not need renewing for nearly 23 years, and that consequently a 3 per cent. depreciation will meet the case. It cannot be experience which leads them to make this extraordinary assumption ; on the contrary, there are many installations in which it has already been necessary to reject the original plant as out of date, and replace it by modern machinery, although not a single one has been in existence for 20 years.

I am not indulging in gloomy forebodings as to the future of municipal electricity undertakings, but merely sound a warning note which will cause the wise to take heed and reflect ere it is too late. If municipalities persist in their present course there will come a time, not very far distant, when further large amounts of money will be necessary to renew their plant, perchance not because it is worn out, but because it will be necessary to keep it up to date.

Is it at all unlikely that cheaper means of production will be adopted within a very few years? Have we not seen such rapid improvements during the last 10 years as to lead

Table I.

Town.	Capital expenditure.	Amount allowed for repairs, maintenance, and depreciation, including sinking and reserve funds, but excluding repairs in generating station.	Probable average annual depreciation excluding repairs in generating station.	Profit as shown on balance-sheet.	Loss as shown on balance-sheet.	Probable annual loss.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Accrington	36,979 5 5	1,058 12 5	1,999 4 3	—	1,558 9 0	2,499 0 10
Ashton-under-Lyne ...	44,818 4 11	1,445 3 1	2,686 19 5	—	907 7 2	2,149 3 6
Barrow-in-Furness ...	54,776 12 7	1,455 2 3	3 442 15 11	—	341 3 0	2,328 16 8
Blackburn	139,814 5 3	6,211 19 6	9,472 5 6	—	1,052 13 11	4,312 19 11
Burton-on-Trent	49,491 9 8	1,062 11 9	3,162 7 1	545 6 8	—	1,554 8 8
Carlisle	46,279 2 5	1,691 14 8	2,924 17 11	206 17 9	—	1,026 5 6
Croydon	210,442 14 4	5,971 8 2	14,600 11 4	2,489 7 8	—	6,139 15 6
Darlington	30,800 6 3	897 15 9	1,630 18 7	90 1 11	—	642 18 11
Darwen	46,887 17 1	1,645 5 3	2,535 12 6	126 17 8	—	763 9 7
Derby	151,273 9 8	4,836 15 1	9,921 6 7	—	2,619 14 9	7,705 6 3
Dewsbury	37,324 0 0	1,298 11 11	2,370 16 10	—	378 5 8	1,450 10 7
Edinburgh	765,611 19 6	30,614 13 10	49,802 17 1	10,295 11 0	—	8,892 12 3
Dudley	40,654 7 7	1,413 3 9	2,532 3 6	—	310 1 7	1,429 1 4
Glasgow	962,726 19 2	31,139 1 11	58,853 10 10	—	—	27,714 8 11
Gloucester	54,434 4 0	623 10 7	3,474 4 6	—	179 3 10	3,029 17 9
Manchester	1,164,307 3 8	39,617 1 7	72,516 6 7	7,634 12 9	—	25,262 12 3
Salford	385,460 19 11	10,780 13 11	23,427 6 5	—	13,214 17 9	25,861 10 3
Southport	161,201 9 10	5,254 19 8	10,617 1 6	1,682 1 5	—	3,680 0 5
Torquay	37,079 4 3	845 19 4	2,657 10 5	183 11 3	—	2,473 19 2

us to expect further developments during the next 10 years? Would any sane business man work on the assumption that what is good in 1903 will be equally good in 1913? The good business man provides for future contingencies and is prepared to keep his plant up to date *out of the proceeds of his business*.

Municipalities should endeavour to do likewise, and after repairs and maintenance of all kinds, create a 5 per cent. reserve fund to provide for renewals as and when required.

The municipal electricity undertaking which cannot do this is losing money, and unless this is done should neither show any profit nor hand over money towards the relief of the rates.

It is, of course, very nice for an electricity committee to tell the ratepayers that by their sagacity and diligence they have produced a profitable undertaking and have rendered a public good. It is very pleasing for the chairman of the committee to reap municipal honours in recognition of his services, and it would be very distasteful to admit a financial loss year after year, but woe to that committee and that chairman who, after issuing balance-sheets showing profits year after year, find themselves in the unhappy predicament of having to make the public admission that *they had forgotten to allow for depreciation*, and that it never occurred to them that plant wears out or is likely to be improved upon, and they must borrow more money to meet the occasion.

It is not difficult, after a little reflection, to understand how it is that municipalities should fall into the error indicated above. It is very unfortunate that the Local Government Board should allow money to be borrowed for such schemes repayable after a period of 30 years or more. If the term for repayment were made 10 or 15 years, so as to demand a correspondingly larger sinking fund, the trouble would be more or less obviated. As it is, however, municipal authorities fondly imagine that all is well if their allowances meet interest and redemption in the stipulated time, and if after doing this there still remains a surplus, they, with childlike simplicity, hand it over to relieve the rates. It is quite true that repairs and minor renewals are provided for out of the revenue, but the main issue at stake, viz., the replacement of the whole plant, is quite lost sight of. As we have shown, it is assumed that the life of the plant as a whole is from 17 to 40 years, the calculation being based upon what is actually allowed for depreciation, sinking fund and repairs. The absurdity is obvious. Would any Insurance Co. issue a life policy at a premium which would take a century to cover the capital amount when the span of life is three score years and ten? Neither can a municipality afford to base its sinking fund on a life of 17 to 40 years, or an average life of 23 years, when the probable average life of the plant will not exceed 10 years. *Experientia docet.* Let them gain their experience and then, perhaps, profit by it.

ELECTRICITY IN MINES.

At the resumed sitting of the Electricity in Mines Committee, held at the Home Office on May 6th under the chairmanship of Mr. Cunynghame, further evidence was given as to the value of the three-phase system in connection with mining work.

Mr. Alexander Siemens considered that all motors on the working face, or those which were supplied through temporary cables, should be limited to voltages of not more than 500; any other electrical machinery might be run with voltages of 5,000 to 6,000.

For big winding and haulage engines, it was better to use continuous current on account of the more efficient speed regulation; two systems might be employed, either direct current taken straight from the generator to the winding motors, or, as in the Siemens & Halske exhibit at Dusseldorf, a buffer battery might be employed in conjunction with what was practically the Ward-Leonard system of regulation. In cases where there were many polyphase motors driven from a central generating station, it was comparatively easy to effect the regulation of individual motors.

He considered that all motors over 120 H.P. should be driven by H.T. current. The reason why large three-phase plant had not been constructed in England was owing to the operation of the Tesla patents, which expired during the last year.

Mr. Siemens exhibited a specimen of steel-braided flexible cable suitable for making motor connections on a coal cutter, having three conductors insulated with vulcanised rubber and wound with jute. This would stand a great amount of hard wear, such as trailing on the ground, and was extensively used by the Admiralty in the stokeholds of H.M. ships. It had been used during the past five years, and was not more expensive than ordinary armoured cable.

Mr. Siemens further explained that less energy would be wasted by transforming a three-phase supply for use on direct-current motors for the main winding equipment, than if three-phase motors were used.

He would not recommend a different class of cable for wet and dry mines—as the latter might become wet—and he would put in the best quality cable everywhere, as it involved only slight extra cost.

Mr. Siemens further gave his views as to the tests which a high quality cable should stand; he considered that flexible cable should be of extra quality to withstand the increased handling.

Prof. Silvanus P. Thompson, Head of the Electrical Department of the City and Guilds of London College, who next gave evidence, considered that three-phase systems of supply would supersede all others for many purposes. If rules were made to regulate the use of electricity in mines with a view to safety, he would, if anything, bar the use of continuous current, and he would not limit the voltage in any way. He considered that machines using H.T. current could be perfectly protected. Induction motors up to 200 H.P. could be made without slip rings, and if the latter were used they could be cased in. The squirrel cage motor was very suitable for coal cutters, despite the varying loads.

He saw no objection to high-voltage circuits being taken down the shaft or further in if necessary, and then transformed down, and he would do everything underground with three-phase plant. He did not think specified "installation" tests would do much good, and would not advocate the earthing of machinery or cables.

Prof. Thompson deprecated the frequent use of fuses, as being possible sources of danger, and did not think regulation standard fuses would prevent the use of temporary expedients.

A safe arrangement of H.T. switchboard was only a question of mechanical design, and there was no more danger in properly designed H.T. apparatus than in the case of low tension plant.

Instances of squirrel-cage motors, up to 900 H.P., were mentioned, where choking coils and auto-transformers in the main circuits were employed for regulating, as being far more efficient than resistances in the rotor circuits.

Further discussion on fuses led to the suggestion that standard fuses could be grouped together, and put in locked boxes, only accessible to authorised persons, as in the case of safety lamps.

Referring to alternating and direct-current systems, he would consider the various cases on their individual merits, and also advocated the use of bare overhead wires for transmission purposes to groups of pits. He did not consider that there was as much danger in using electricity underground as in using miners' lamps, and it had undoubtedly a great future before it.

Electrical Exhibition. — Local exhibitions have frequently been a means of arousing increased interest in electricity for lighting and driving purposes among hitherto apathetic residents. It is to be hoped that the exhibition which has just been held at Guildford, will produce a like result, and that the Guildford Electricity Supply Co., which has had anything but smooth sailing, will feel the benefit. The exhibition was opened by the Mayor on Tuesday last week, and it was under the direction of Mr. Alderton, the company's resident engineer. The exhibitors included the Dowsing Radiant Heat Co., British Prometheus Co., British Westinghouse Co., Godalming Electricity Supply Co., Messrs. Bowden & Higlett, Messrs. Gill & Carling, and, of course, the Guildford Electricity Supply Co.

ROYAL COMMISSION ON LONDON TRAFFIC.

Sir David Barbour presided on Friday, 8th inst., over a further meeting of the Royal Commission on London Locomotion, when Mr. W. H. Dickinson, the chairman of the special committee of the London County Council appointed to consider the question, was further cross-examined on the recommendations made by that committee which he gave at the previous sitting, and which were fully set out in our last issue. Witness said the Council always tried to get the Cheap Trains Act incorporated in Bills coming before Parliament affecting London, and nearly always succeeded. When they wanted to get the fares of railway companies revised, and get workmen's trains, they had to go to the Railway Commissioners, and they had to show the Commissioners that there were sufficient workmen to create a demand. That was reasonable so far, but the difficulty was that on some suburban lines they could not force the railway companies to increase their workmen's trains until the population had grown. They were anxious, therefore, to try and get the railway companies to give workmen's fares in anticipation of the population growing, so that workmen might go and live in those parts of London.

By Mr. Gibb: They wanted to be able to compel the companies to give workmen's fares in anticipation of a demand. He thought the tribunal which had been suggested should be given such power.

By Sir J. Wolfe Barry: Have you considered the question of assisting the railway companies by some subvention? All the burdens appear to be placed on the railway companies?—No; in the end it is an advantage to the companies.

If it succeeds it succeeds, but the companies have to take the risk?—Yes; the question of local authorities assisting has not been considered.

Supposing the L.C.C. thinks it is desirable to run workmen's trains in a certain district, and there is not a sufficient amount of traffic. They might say they were prepared to give the company a certain amount to make the experiment. Don't you think that a reasonable way of dealing with the question?—We are rather doubtful about a public authority assisting private enterprise financially. It would be very difficult to know who to help.

Replying to other Commissioners on the point, Witness said it was a very large question, although, perhaps, it might help the difficulty.

In answer to the Chairman, Witness said he had not formed any idea of what the limit of dividend of the tube railways should be. They put the proposition rather generally. He believed under the Railway Act of 1884 the dividends were limited to 10 per cent., and that when that figure was arrived at the excess went to the reduction of fares, and some such system might be satisfactorily applied to the tube railways in London. There was a great deal of amalgamation going on with the tube railways, and they certainly thought there should be some power to revise rates when the profits got to a certain point.

The Chairman: That might check improvements. When the railway company had got to the limit, it might say, "We will not make any more improvements"?—Of course, there is that.

Continuing, Witness advocated the insertion of a purchase clause similar to that in the Tramways Act, in all new tube railway Bills. In the present tube railway Bills no provision was made for a sinking fund. As to the advantage of having such a purchase clause, he thought it was a mistake to give an absolutely permanent concession to companies of this kind.

Sir J. Wolfe Barry: If you bought the Metropolitan and District Railway Companies, would you work the whole thing?—I should lease it for a short term.

Do you think that that would be any advantage to the travelling public?—I certainly think it would be.

Continuing, Witness admitted than in London the railways had most acute competition.

Mr. Gibb: Do you contemplate purchase at a less price than the concern would be worth?—Yes; at less than it is worth for profit-making, otherwise there is no advantage.

Sir J. Wolfe Barry: Take the urban railways of London. Do you know one of them that is making a really good dividend, and which could at the present time make a sinking fund?—I know the existing tube railways are making little now.

Take the two old railways—the Metropolitan and the District. One is making no dividend at all, and the other is making a very small dividend?—Yes.

Then where is the money to come from to provide a sinking fund?—Even if they cannot, I do not think that affects the broad principle.

But if they cannot provide a sinking fund, you still further discourage the independent promoters?—I do not want to discourage the independent promoters, as they have difficulties already with these tube railways.

That is what I am trying to show. If a purchase clause is to be made obligatory, then, if the railway is remunerative, it is to be taken over; but, if it is not remunerative, it is to be left alone. Is not that a discouragement to the independent promoter?—We cannot really say what the result will be for many years.

By Sir T. Bartley: The length of lease which might be granted when an undertaking was taken over by the local authority would entirely depend on the terms. If capital had to be spent, the lease might have to be 40 or 50 years.

The Chairman: Your proposal is, that the railway should be purchased and not confiscated?—Certainly.

Sir Francis Hopwood: But you object to purchase as a going concern?—Yes. I object to giving a concession for 60 years and then purchasing as a going concern.

Earl Cawdor: But you ask for power to interfere with rates in the meantime?—Yes.

Would not that, coupled with the company having no power to make a sinking fund, restrict the possibility of raising their capital?—It would certainly make it less easy to raise capital. Everyone of these conditions would.

Would there be any certainty of any revenue to put before the investor at all?—Yes I should say there would be.

What would be the conditions under which you could assure a revenue?—It would be precisely the same conditions as apply now to the Electric Light Companies. They are subject to a revision of rates which are revised by the Board of Trade under certain conditions.

Sir Francis Hopwood: But the purchase clause is very different from that of the Tramways Act. We have had no experience of it yet, but is not the true view that the clause is for the purchase by the local authority as a going concern?—The electric lighting clause has not yet been construed.

Lord Ribblesdale: Do you think the dividends paid by the tube railways will be so small that there would be no sinking fund?—I do not assume that; Earl Cawdor does. At present the tube railways are not paying much.

Further examined, Witness said the same principle with regard to sinking fund as obtained with the water companies should be applied.

The Chairman: If the tribunal attempted to impose conditions which the investing public would not accept, I suppose the scheme would fall through?—Yes, it must, of course.

And in that case, if the tribunal thought the railway ought to be made they would revise these conditions?—I think that would be the argument.

By Sir J. Wolfe Barry: He did not say he would buy under price, but he said he would purchase a railway at a price, not actually the market value of the undertaking as a going concern.

Further examined by Earl Cawdor, Witness said he did not know that he could say they ought to purchase at the capital cost, as money might have been wasted.

Would there be no security for the return of the capital invested in the concern?—I do not know that there would be any more security than would be the case with a company with a concession abroad.

Then we may take it that there is to be no absolute security to give at all?—I do not think we are called upon to give more security than at present.

But there is no reversion now, and that would mean a very material change in the present position of the company?—At the present moment, I believe the Government has the right of purchase of any railway upon paying 25 years' purchase on its income.

Mr. Gibb: The difficulty, if you will allow me to say so, is in the inconsistency of your answer. You will pay market value when it is less than cost, but you won't pay market value when it is more than cost?—I do not know quite what I did say on the matter.

Witness was next examined by the Chairman with regard to his objections to the amalgamation of tube railways, who would have to comply with the conditions on which they were allowed.

Witness pointed out that in the case of the tube railway controlled by Mr. Yerkes, the proposal was to allow the railways to be worked by a company which was not a statutory one, and which would guarantee a dividend.

The Chairman: But the public, apparently, will not be any worse off than before?—Except that the public will not have the opportunity of raising questions which are constantly raised when a statutory company comes before Parliament.

If amalgamation were carried out under reasonable conditions, it would be for the benefit of the public?—I think it would be.

Proceeding, Witness reiterated the opinion he expressed at the last sitting that the London County Council should not be under the jurisdiction of the tribunal with regard to its tramways. He did not think the City should have any veto over the L.C.C. They had failed to make arrangements with the Middlesex County Council with regard to the joint working of the tramways of the two authorities. At present the L.C.C. did not work the northern tramways, and the Middlesex County Council were entering into arrangements with two or three companies with regard to the working of the tramways, some of which were in London. There were one or two companies working the tramways in Middlesex and Essex, and the L.C.C. were most anxious to prevent them coming into London. Of course, when the tramways were all electrified, they would have to enter into arrangements for running powers, and they were quite willing to do this, but they were anxious to maintain their position as the constructors of the tramways. He would prefer not to say anything as to the profits of the Council's tramways, or as to the cost of the electrification exceeding the estimates.

St. Louis Exposition.—Plans for the illumination of the central tower of the Administration Building of the Exposition have been perfected by chief electrical engineer, Mr. Henry Rustin. The tower will stand out a blaze of light, produced by 6,000 incandescent lamps. The current for this will be drawn from the power plant on the University portion of the grounds. The vertical line of the two hexagonal turrets on the front of the tower will be marked out in lines of light. A line of light will also mark the archway. Between the two turrets a giant American flag, occupying the entire space, following the colours of "Old Glory," red, white and blue, will wave in the breeze. The machinery by which this effect will be produced is what is known as the Elbright system. The entire composition will have the effect of a giant construction of light supporting "Old Glory."

STEAM PIPE COVERINGS.—I.

Few engineers possess any real knowledge of steam pipe coverings, at least to such an extent as to enable them to say that a given article was superior to another, either in first cost, efficiency, or durability. Pipe coverings are looked on as something hardly worth consideration, and where pipes are allowed to be covered, it is usually done as a kind of painful necessity, with no regard as to whether the thickness adopted is proper to the circumstances. For temporary power installations the thickness of the covering must obviously be less than what it will be proper to adopt on permanent pipe work. The expense of pipe coverings is made up of interest on first cost, maintenance charges and sinking fund. It will usually cost but little more to add 50 per cent. to the thickness of the covering when this is first done. An extra ½ in. of covering will not save 50 per cent. more steam than is saved by a covering of 1 in., nor will it cost 50 per cent. more. Before it can be decided whether an extra ½ in. is advisable, its power to save heat must be known, and one must also know how many years it is likely to endure.

Thus a covering which costs 1d. a year in interest and 1d. for sinking fund, to last five years, must save 2d. to be commercially worth applying. But if a life of 10 years is visible ahead, there will be an extra five years at 1d. after paying up the sinking fund, and there would be 5d. sure profit. In addition to the *primâ facie* economy of a pipe covering, there is possible a further economy of steam generating plant. This may be more or less fortuitous.

By covering steam pipes, an existing boiler plant might be made to serve where otherwise an extra boiler would be needed; but where the plant is already ample, the difference might be unappreciable. But in any case it is desirable to have an approximate knowledge of the economy of heat due to a unit weight of covering composition of different thicknesses.

About November, 1901, Mr. Barrus made a series of tests with various coverings, with a view to elucidate facts. The net result was as it always is—a demonstration of the fact that it is to closely-imprisoned air that the effect of any covering is due. Hair felt is the ideal covering, but it is unsuitable for high temperatures. Next come various thin superposed layers of corrugated stuff, which lock up many layers of air. The tests lasted in many cases for a month of eight hours per day, and the various materials tried were all marketable articles bought in the usual way from dealers.

All the tests were condensation tests, the weight of steam condensed in a given time per unit area being inversely as the efficiency of the covering. It is so easy to weigh the result, which is in the article which it is designed to economise. Suitable precautions were taken, such as cooling the escaping water in order to avoid loss of weight through vaporisation. Coverings were put on to the manufacturer's standard. Large pipes usually were covered more thickly than small pipes.

It was found that there was no difference whether the steam was standing still in the pipe or was moving. This made the operation of testing easy.

The pipes were tested both bare and covered, and ranged from 2-in. to 10-in. sizes. It would be of no use to enumerate the tested samples by name as they were all of American make.

Two were of the cellular type of alternate layers of plain and corrugated sheet. Others were probably mixtures of plaster of paris and fibre of asbestos, and a third variety was of concentric layers of asbestos paper with the corrugations run round the pipe.

The best of all coverings was a sheet made up of hair-felt and asbestos in many laminations. With 59 laminations of thin sheet as against 48 of thick, of almost equal total thickness, the efficiency was increased by 8 per cent. This sheeting is partly compounded of sponge.

The loss of heat from a pipe-covering is proportionate to the area of the outside of the covering. A cover of 1 in. doubles the diameter of a 2-in. pipe, but adds very little to a 10-in. pipe. The loss is thus different for different pipe diameters. The smaller pipe, of course, exposes less area to the covering in proportion to the area of the outside of the covering. The effect of the covering is thus less with small than with large pipes.

In result, the heat lost by 10-in. and by 2-in. pipes was practically the same per unit difference of temperature and per unit of external area of cover. The effect of thickness upon efficiency appears to be such that the heat units loss, is inversely as the thickness to the $\frac{1}{8}$th power.

Coverings made for high-pressure work really much better than low-pressure coverings, having an efficiency of 84·6 per cent., against 75·2 per cent. in the latter case.

High-pressure coverings cost at the end of five years $14·7, against $18·5 for low-pressure coverings at the same pressure of 80 lbs., whence the conclusion that the dearer high-pressure materials are cheaper even for low-pressure work.

Surface temperature is not to be relied on. There is evidently something in heat radiating power.

Materials moulded on do not receive much appreciation. They all tend to resolve themselves into their original powders.

Where a bare 10-in. pipe at 150 lbs. pressure lost 109·39 lbs. through condensation, it lost only 10·84 lbs. with the best covering, and at 80 lbs. only 8·7.

Stated roughly, coverings diminish heat loss by 75 to 90 per cent. To leave pipes bare, costs from 5s. to 6s. per sq ft., according to the pressure. Coverings may be paid for, four times over per year in coal saved.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"Statutory" writes:—"There are two authorised undertakers in two areas adjoining one another, and each of these undertakers owns and operates electric lighting works in each area. There is a large manufacturing firm whose premises adjoin the boundary of one of the undertakers' area, but are *wholly* situated in the area of the other undertaker. (1) Can the undertaker in whose area the premises are *not* situated run his cables to the boundary line between the two areas (which corresponds to the boundary of the premises to be supplied) and supply him, or is this prohibited under Section 4 of the Electric Lighting (Clauses) Act, 1899, by paragraph 2. Can you give any cases which have been decided in the Courts as to injunctions or other remedies where authorised undertakers have contravened this section? (2) Would a similar decision prevent one undertaker supplying the other in bulk, assuming that the gas company did not raise any question?"

*** It is provided by Section 4 (2) of the Schedule to the Electric Lighting (Clauses) Act, 1899, that undertakers shall not at any time after the commencement of the special order supply energy or (except for the purposes of that order) erect or lay down any electric lines or works beyond the area of supply, otherwise than under the authority of Parliament, or under a license granted by the Board of Trade under the principal Act. It is not stated whether the "authorised undertakers" mentioned by "Statutory" are local authorities or private companies, but it is presumed that the above section forms part of their provisional orders. Although there does not seem to be any decision expressly in point, it is conceived that the section above set out would prevent the supply in question being given, inasmuch as it amounts to a supply outside the area, for *like* electricity it is supplied when it is consumed. The case of the Gas Light & Coke Co. *v.* South Metropolitan Gas Co. (62 L.T. 126) is useful in this connection. By the Metropolis Gas Act, 1860, Sec. 6, the limits of each gas company then supplying the metropolis were defined, and in the result each company enjoyed a practical monopoly in its own district. One of these companies, at the request of a railway company, placed a meter on a part of a railway station lying within the company's limits, and through it supplied gas to other parts of the premises situated outside the company's limits, and within the limits of another company. The House of Lords held this to be unlawful on the ground that the sale and delivery of the gas took place at where it was consumed, and therefore that the company were transgressing their authorised limits.

With regard to the second question, the delivery of electricity in bulk would also constitute an infringement of statutory right, unless the provisional order contained a special clause to permit it. Such clauses are common in modern orders. See Wolverhampton Corporation Act, 1899 (62 and 63 Vict. c. cclix, Sec. 63), and Mansfield Corporation Act, 1901 (1 Edw. 7, c. xcvii). The following is the ordinary form of such a clause:—

"If the local authority for any district adjoining the area which the Corporation are for the time being authorised by provisional order confirmed by Parliament to supply energy in any such district, the Corporation and any such local authority or company may, with the approval of the Board of Trade, enter into and carry into effect agreements for the supply of electrical energy in bulk by the Corporation to such local authority or company."

Unless there is a clause of this kind in the order in question, supply beyond the district would clearly be *ultra vires*.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

9,446. "Improvements in switches for the making and breaking of electrical circuits." F. S. Carter. April 27th.

9,496. "Improvements in the generation, distribution, and control of electric currents and in mechanism connected therewith, the invention being particularly applicable to train lighting and other purposes." P. M. Justice. (The Electric Car Lighting Co., United States.) April 27th. (Complete.)

9,528. "Improvements in or relating to automatic switches for remote control of electric current." D. B. McBride. April 28th.

9,531. "An improved method of, and means for, electro-depositing metal on parabolic reflectors and analogous articles." B. J. Bound and A. Bound. April 28th.

9,535. "Improvements in and connected with electric time relay switches." W. W. Lackie, W. T. Calderwood and W. H. D. MacEwan. April 28th.

9,551. "Improvements in or relating to electric governors for elastic fluid turbines." A. J. Boult. (Continental Turbine Co., United States.) April 28th. (Complete.)

9,552. "Improvements in and relating to apparatus for controlling the lighting and extinguishing of gas, the flow of liquids or the supply of electrical energy at predetermined times." H. W. Harris. April 28th.

9,553. "New method and device for the transmission of messages by telegraph." W. Hamilton. April 28th.

9,554. "Improvements in connection with the trolley wires of electric tramways and the like." D. Ashworth. April 28th.

9,571. "Improvements in storage batteries." F. A. Feldkamp. April 28th. (Complete.)

9,576. "Improvements in and relating to telephonic apparatus." F. W. Wood. April 28th.

9,586. "Improved mechanism for controlling electric circuits." G. A. Tate and F. E. Newbery. April 28th. (Complete.)

9,592. "An improved galvanic battery." A. Bourdos and A. E. Ann. April 28th.

9,612. "Improvements in electric switches specially adapted for use with trolley lines." A. J. A. G. Marichal. April 28th.

9,623. "Improvements in reflectors for incandescent electric lamps." F. Cartier. April 28th.

9,639. "Improvements relating to electrical testing apparatus." A. G. Cook, T. E. Gambrell and C. T. Gambrell. April 29th.

9,642. "Improvements in means for regulating electric switches." H. Leitner and R. N. Lucas. April 29th.

9,649. "Improved means for transmitting electric current to tramcars and like." A. Hirst & Son, Ltd., and H. Hirst. April 29th.

9,656. "Improvements applicable to the 'live wires' of electric tramways." A. Tcherniack. April 29th.

9,692. "Improvements in electric railways." W. N. Stewart. April 29th.

9,712. "Improvements in connection with electric railway systems." A. T. Cooper. April 29th.

9,716. "Improvements in or relating to an arc lamp, with oxygen-pump." H. E. W. Leymanns and W. Keim. April 29th. (Complete.)

9,728. "Improvements in or relating to electric connecting devices applicable to lampholders, wall plugs and the like." C. L. R. E. Menges. April 29th.

9,744. "Improvements in automatic switches and line sectors for intercommunication telephones." C. Wakeman. April 30th.

9,778. "An appliance for switching junction points of tramways or railways, and also the power cable junctions on electric systems." P. Tomlinson. April 30th.

9,809. "Improvements in devices for detecting high voltage in electrical circuits and apparatus." E. A. Carolan. (The General Electric Co., United States.) April 30th.

9,810. "Improvements in electric fuse boxes." E. A. Carolan. (The General Electric Co., United States.) April 30th.

9,811. "Improvements in methods of winding dynamo-electric machines." E. A. Carolan. (The General Electric Co., United States.) April 30th.

9,821. "An improved device or devices for locking incandescent electric lamps to their holders." A. W. Hill and Sir Hiram Maxim Electrical and Engineering Co., Ltd. April 30th.

9,831. "Improved process and apparatus for the production of metals of the alkali group by electrolysis." E. A. Ashcroft. April 30th.

9,832. "Improvements in or relating to electric lamps." W. Boehm. April 30th.

9,875. "Improvements in static electrical machines." H. Nehmer. May 1st.

9,895. "Improvements in electric generators." B. H. Thwaite. May 1st.

9,932. "Improvements in treating materials by radiated or reflected heat in electric furnaces." F. W. Howorth. (Trollhattans Elektriska Kraftakiebolag, Sweden.) May 1st. (Complete.)

9,935. "Improvements in the manufacture of accumulator plates and in tools therefor." F. R. Simms. May 1st.

9,951. "Improvements in central energy telephone systems." B. Brander. May 2nd.

9,990. "Improvements in or connected with electric motors and generators." V. A. Fynn. May 2nd.

9,998. "Improvements in or connected with electric arc lamps." H. J. Norbalie and T. G. Fulkes. May 2nd.

PUBLISHED SPECIFICATIONS, 1901.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

24,192. "Protective mechanism for high tension systems of electrical distribution." E. de Pass. (R. V. Cheatham and J. A. Stewart.) Dated November 28th.

24,218. "Improvements in switches for use with lamp-posts for street lighting and the like." W. Sumner. Dated November 28th.

24,227. "Improvements in speed regulating means for electric motors." B. G. Lamme. Dated November 28th. (Date applied for under Section 103 of Patents, &c., Act, 1883, April 30th.) Dated November 28th.

24,228. "Improvements in windings for electrical machines." B. G. Lamme. (Date applied for under Section 103 of Patents, &c., Act, 1883, April 30th.) Dated November 28th.

24,234. "Improvements in the obtainment of metals and alloys, and in furnaces to be employed therein." C. A. Keller. (Date applied for under Section 103 of Patents, &c., Act, 1883, July 6th.) Dated November 28th.

24,276. "Improvements in or relating to electric arc lamps." Jandus Arc Lamp and Electric Co. and A. D. Jones. Dated November 29th.

24,277. "Improvements in and relating to plates for electric storage batteries." C. S. Kaufmann. Dated November 29th.

24,307. "Improvements in multiplex telegraphy using undulating or alternating currents." W. P. Thompson. (Soc. des Telegraphes Multiplex.) (Systeme E. Mercadier.) Dated November 30th.

24,457. "Improvements in method of and means for suspending overhead electric conductors." British Thomson-Houston Co. (Union Electricitäts-Gesellschaft, Berlin.) Dated December 2nd.

24,511. "Improvements in or relating to electrodes for electric accumulators or batteries." A. Bainville. Dated December 2nd.

24,616. "Improvements relating to incandescent electric lamps." Soc. Italiana di Elettricita gia Cruto. (Date applied for under Section 103 of Patents, &c., Act, 1883, September 13th.) Dated December 3rd.

24,621. "Improvements relating to electric incandescent lamps." Soc. Italiana di Elettricita gia Cruto. (Date applied for under Section 103 of Patents, &c. Act, 1883, September 13th.) Dated December 3rd.

24,637. "Improvements in electric batteries." L. M. G. R. d'Infreville. Dated December 3rd.

24,638. "Improvements in lanterns for electric incandescent lamps." F. C. Fleming. Dated December 3rd.

24,666. "Improvements in or relating to dynamo-electric generators for igniting the charges in gas and oil engines and other purposes." F. T. Reid and W. Sheperd. Dated December 4th.

24,672. "Improvements in and connected with electric motors for driving spinning machines." H. Schonfeld. Dated December 4th.

24,686. "Improvements in or relating to street lamp fittings for incandescent electric lamps." W. C. C. Hawtayne. Dated December 4th.

24,737. "Improvements in portable electric batteries or combined batteries and lamps." M. Sutherland and E. Marcuson. Dated December 5th.

24,797. "Improvements relating to electrical motors." D. P. Burdon and E. F. Cavalier. Dated December 5th.

24,803. "Improvements in controlling electric motors." British Thomson-Houston Co. (H. W. Buck, Niagara Falls, U.S.A.) Dated December 5th.

24,804. "Improvements in switching apparatus for alternating electric currents." British Thomson-Houston Co. (E. M. Hewlett, Schenectady, U.S.A.) Dated December 5th.

24,805. "Improvements in electrical measuring instruments." British Thomson-Houston Co. (R. H. Read, Schenectady, U.S.A.) Dated December 5th.

24,807. "Improvements in electric controllers." British Thomson-Houston Co. (F. E. Case, Schenectady, U.S.A.) Dated December 5th.

24,808. "Improvements in coupling devices for electric conductors." British Thomson-Houston Co. (F. E. Case, Schenectady, U.S.A.) Dated December 5th.

24,809. "Improvements in electric brakes." British Thomson-Houston Co. (W. B. Potter, Schenectady, U.S.A.) Dated December 5th.

24,810. "Improvements in charging stations for electrically-propelled vehicles." British Thomson-Houston Co. (C. E. Holmes and F. P. Cox, both of Lynn, U.S.A.) Dated December 5th.

24,811. "Improvements in controllers for electric motors." British Thomson-Houston Co. (L. A. Tirrill, Lynn, U.S.A.) Dated December 5th.

24,812. "Improved means for signalling between drivers on electrically-propelled trains." British Thomson-Houston Co. (W. B. Potter, Schenectady, U.S.A.) Dated December 5th.

24,816. "Improvements in electric railways." C. J. Kintner. (Date applied for under Section 103 of Patents, &c., Act, 1883, May 6th.) Dated December 5th.

24,825. "Improvements in methods for producing electric waves." J. A. Fleming and Marconi's Wireless Telegraph Co. Dated December 5th.

24,839. "Improvements in and relating to telephone systems." P. Arnheim. Dated December 5th.

24,887. "A new and improved method of automatically and intermittently closing of electrical circuit which can be used in connection with railways." W. E. Burgess. Dated December 6th.

24,937. "Improvements in polyphase alternating current induction motors." W. Davies-Langdon and A. Soames. Dated December 6th.

24,992. "Improvements relating to electric primary cells or batteries." A. P. Tully. Dated December 7th.

25,000. "Improvements in electro-automatic mechanism for advertising devices." F. de Blanco. Dated December 7th.

1902.

3,617. "Improvements in and relating to combined electrical piano-playing and recording attachment." G. H. Davis. Dated February 12th.

5,209. "Improvements in and relating to magnetic ore separators." F. J. King. Dated March 1st.

5,718. "An improved magneto-electric igniter for explosion motors." T. Bergmann. Dated March 7th.

5,981. "Improvements in rail bonds or connections for electric railways." G. B. Blanchard. Dated March 11th.

6,484. "Improvements in or relating to signalling devices for telephone systems." H. T. Cedergren. Dated March 17th.

6,485. "Improvements in or relating to telephone systems." H. T. Cedergren. Dated March 17th.

10,452. "Improvements in wireless telegraphy and means therefor." J. E. Evans-Jackson. (Communicated U.S.A.) Dated May 6th.

11,076. "Improvements in electric arc lamps." British Thomson-Houston Co., Ltd. (E. W. Rice, Jun.) Dated May 14th.

11,103. "Improvements relating to electric heaters and rheostats." M. C. Krueger. Dated May 14th.

11,508. "Improved process for the preparation of electrodes for secondary batteries." W. P. Thompson. (Communicated.) Dated May 20th.

12,474. "Improvements in wireless telegraphic and telephonic systems." H. Shoemaker. Dated May 31st.

12,570. "Improvements in and relating to telephonic instruments." J. B. Birnbaum. Dated June 2nd.

12,780. "Improvements relating to telephone installations." P. Hardegen. Dated June 11th.

14,297. "Improvements in electric time switches." C. F. Heath. Dated June 24th.

14,386. "Improvements in or relating to the electrolytic manufacture of chlorates and perchlorates." P. L. E. Lederlin. Dated June 25th.

14,676. "Improvements relating to electric railways on the surface contact system." W. M. Brown. Dated July 1st.

14,862. "Improvements connected with electrical controlling means for elevators or lifts and other apparatus." Otis Elevator Co., Ltd. Dated July 3rd.

14,947. "Improvements in or relating to electric systems." C. F. Baudry. Dated July 4th.

14,963. "Improvements in automatic trolley catches." T. B. Shanahan. Dated July 4th.

16,191. "Improvements in electric signalling apparatus for railways." W. J. Hare and J. P. Hare. Dated July 21st.

16,394. "Improvements in or relating to electric resistances and to the method of using the same for electrical measurements." G. L. Addenbrooke and L. Robinson. Dated June 23rd.

16,402. "Improvements in wireless telegraph systems." H. Shoemaker. Dated July 23rd.

16,887. "Improvements in the framing of dynamo-electric machines and electro-motors." Siemens Bros. & Co. (Siemens & Halske, Germany.) Dated July 29th.

16,983. "Improvements relating to rail connections for electric railways." H. H. Lake. (Continuous Rail Joint Co., U.S.A.) Dated July 31st.

17,202. "Improvements in holders for the commutator brushes of dynamo and other electric machines." F. S. Weidaw and F. L. Barney. Dated August 5th.

17,469. "Bearings for trolley wheels and the like." M. Steiner. Dated August 8th.

17,691. "Improvements relating to armature windings for induction motors." H. H. Lake. Dated August 12th.

17,703. "Improvements relating to signalling by electro-magnetic waves." R. A Fessenden. Dated August 12th.

17,706. "Improvements in wireless signalling." R. A. Fessenden. Dated August 12th.

17,712. "Improvements in hot wire electric meters." R. S. Stewart. Dated August 12th.

18,341. "Improvements in telephone installations having a central microphone battery." Siemens Bros. & Co., Ltd. (Siemens & Halske, Germany.) Dated August 20th.

18,580. "Improvements in telegraphic apparatus for double transmission by pulsating and continuous currents." W. L. Wise. (Communicated, U.S.A.) Dated August 23rd.

18,808. "An improved electric belt for medical purposes." E. Smellie. Dated August 27th.

18,854. "Improvements in measurement of the energy of electric currents." W. Stanley. Dated August 27th.

18,859. "Improvements in the generation and distribution of electrical energy." W. Stanley and J. F. Kelly. Dated August 27th.

19,420. "An improvement in electric switches." O. Imray. (Communicated, U.S.A.) Dated September 4th.